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ERRATA

VOL. XLI, No. 4.

Page 901, Misc. Note No. XV, line 2 *for* 'Palasbani' *read* 'Palasbari'.

VOL. XLII, No. 2.

Page 270, line 5 from bottom *for* 'Muni' *read* 'Mini'.
Misc. Note No. I, p. 434, line 10 *for* 'Subansini' *read* 'Subansiri'.
,, ,, ,, line 17 *for* 'Rangdoi' *read* 'Rongdoi'.
,, ,, ,, line 17 *for* 'Kenua' *read* 'Kerua'.
,, ,, ,, line 18 *for* 'Rongdoi-Laikoaghat' *read* 'Rongdoi-Saikoaghat'.
Page 452, line 12, *for* 'Bhauddin' *read* 'Bahauddin'.
,, ,, line 13, *for* 'Ahmedabad' *read* 'Junagadh'.

VOL. XLII, No. 3.

Page 476, line 18, *for* '(3000 ft.) in coll. m.' *read* 'Holo-type, 0, 27-x-40, Sineh Safid ; in coll. m.'.
,, ,, line 20, *for* 'Subsp. n. and sp. dist.' *read* 'Subsp. n. an sp. dist'.
,, 477, line 18 *for* 'but curved slightly based' *read* 'but curved slightly basad'.
Misc. Note No. XIV. p. 668, in the heading of the note *for* 'Assam' *read* 'North Bengal'.
,, ,, ,, p. 668, in line 1, after list of species *for* 'Specimens' *read* 'Specimen'.

VOL. XLII, No. 4.

Page 762, Plate III, facing the page, Fig. 2 *for* the word 'Dhoby' *read* 'Dhoti'.
,, 903, Wherever 'Fig. 1' appears on the Plate and the letterpress *read* 'Fig. 2', likewise in the place of 'Fig. 2' *read* 'Fig. 3'. Fig. 1 was not published.

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BAUHINIA GALPINI N. E. BROWN

(93·4 per cent nat. size)

JOURNAL
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Bombay Natural History Society.

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SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

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PART V.

(*Continued from Vol.* xli, *No.* 4 (1940), p. 690).

(*With* 1 *coloured and* 3 *black and white plates, and* 7 *text-figures*).

Bauhinia Linn.

The genus *Bauhinia* was created in honour of the brothers Jean and Caspar Bauhin, French herbalists of the sixteenth century, in consequence of most of the species having their leaves composed of two lobes, which are either quite separate, or, more frequently, joined by a portion of their inner margins. This arrangement of the leaves was considered to be symbolic of the great services the two brothers had rendered to science.

The genus belongs to the family *Caesalpineae,* which was formerly considered to be a subsection of the *Leguminosae,* or sweet-pea family. The flowers are, however, not papilionaceous and the *Caesalpineae* is considered to be distinct from, though closely allied to, other sections of the *Leguminosae, Papilionatae* and *Mimoseae,* and like them has been given full family rank.

Blatter and Millard in *Beautiful Indian Trees* have treated two tree species, *B. variegata* and *B. purpurea,* but the genus contains a number of other species, shrubs and climbers, which are cultivated in gardens in this country on account of their showy flowers or handsome foliage.

The characters of the genus are as follows:—

Trees, shrubs or climbers, the latter with tendrils. Leaves alternate, compound, usually consisting of two leaflets which are

joined together by the lower part of their inner margins, simulating a 2-lobed leaf. The top of the common rib or nerve between the 2 leaflets is produced as a small spur; a vestigial structure which represents the remains of the rhachis of the compound leaf. The flowers are showy and are arranged in simple or panicled, terminal or axillary racemes. Calyx tube sometimes long and cylindrical, sometimes short and turbinate, with the disk produced to the top; limb entire or spathaceous or cleft into 2 or 5 teeth. Petals 5 in number, slightly unequal, usually narrowed at the base into a claw, variously coloured, ranging from red to purple, white or yellow. Stamens 10 or reduced to 5 or 3, if less than 10 with sterile filaments absent or present; filaments free, filiform. Anthers versatile, dehiscing longitudinally. Ovary seated on a stalk (gynophore); ovules usually many. The style is long or short and usually curved, ending in an oblique or terminal stigma. The fruit is a linear pod, dehiscent or indehiscent.

In many species the flowers are fragrant, and this characteristic combined with their showy appearance points to pollination through the agency of insects.

It is well known that the cotyledons of dicotyledonous seedlings, which are widely spread during the day, press their inner surfaces together during the night in order to prevent loss of heat and to protect the tender first leaves. This phenomenon is particularly well seen in the seedlings of all Bauhinias. The cotyledons, moreover, seem to function as ordinary foliage leaves to some extent, as well as performing their role of reservoirs of food.

Bauhinia Vahlii, a climber, often reaches a length of over 100 yards and scrambles over the tallest trees. The exceedingly tough and fibrous bark of this particular species had, and still has, a great reputation as a suitable material for making strong ropes. Before steel came into use, ropes made from this species were used to carry suspension bridges. About the middle of the 19th century the ropes for the suspension bridge over the Jumna at Kalsi were made from the bark of *B. Vahlii.*

The bark of certain Indian species smoulders very slowly when set alight. This property was made use of in bygone days to construct the slow matches whereby primitive artillery were discharged. Now-a-days such torches are often carried by cattle-boys to free themselves from the attention of sandflies and other insects.

Key to the Species.

Erect or prostrate shrubs.
- Stems spiny. ... ... *B. candicans.*
- Stems not spiny.
  - Stamens 10.
    - Flowers usually in axillary pairs ... ... *B. tomentosa.*
    - Flowers in axillary racemes. ... ... *B. acuminata.*
  - Stamens 3 ... ... *B. Galpini.*

Climbers.
- Stems flattened and undulate ... ... *B. anguina.*
- Stems cylindrical.
  - Leaves very large, 4 in. to 18 in. long ... ... *B. Vahlii.*
  - Leaves small not longer than 1.5 in. ... ... *B. corymbosa.*

Bauhinia candicans Benth.

(*candicans* means hoary, covered with white hairs).

Fig. 1.—*Bauhinia candicans* Benth. × 2/3.

Description.—A shrub or small tree with zigzag, very hoary, tomentose branches. Leaves compound, 2-3 in. long, ovate or somewhat oblong, shallowly cordate at the base, 2-lobed for one-third or almost to the base, with the common midrib produced as a short spur, 11-13-nerved from the base; glabrous on the upper surface, very hoary below, petiolate, stipulate; lobes obtusely rounded at the top; petioles hoary, up to 1 in. long; stipules represented by a pair of stout thorns.

Flowers few, in axillary racemes. Pedicels short. Calyx tube short, turbinate, hoary. Calyx-limb spathaceous; segments valvate and connate in the bud, shortly 5-lobed at the apex, up to 2.5 in. long, densely and shortly hairy outside. Petals 5, free, long-clawed, with a pronounced midrib, spathulate, creamy-white in colour, opening at night. Stamens 10; 5 on short, 5 on long filaments; filaments bound together at the base by a short membrane which is apparently a prolongation of the disk. Ovary seated on a long gynophore, hairy, glabrescent, ending above in a long style and

capitate stigma. Pod dehiscent, very leathery, polished, 3-4 in. long.

Flowers.—June-July. *Fruits.*—Oct.-Nov.

Distribution.—A native of Brazil, now commonly cultivated throughout the plains of India.

Gardening.—An almost evergreen shrub with large creamy white flowers which usually open in Dehra during the night and last only for a day. Easily raised from seed.

Bauhinia tomentosa Linn.

St. Thomas-Tree.

(*tomentosa* is a Latin word meaning hairy and refers to the hairness of the leaves and pods).

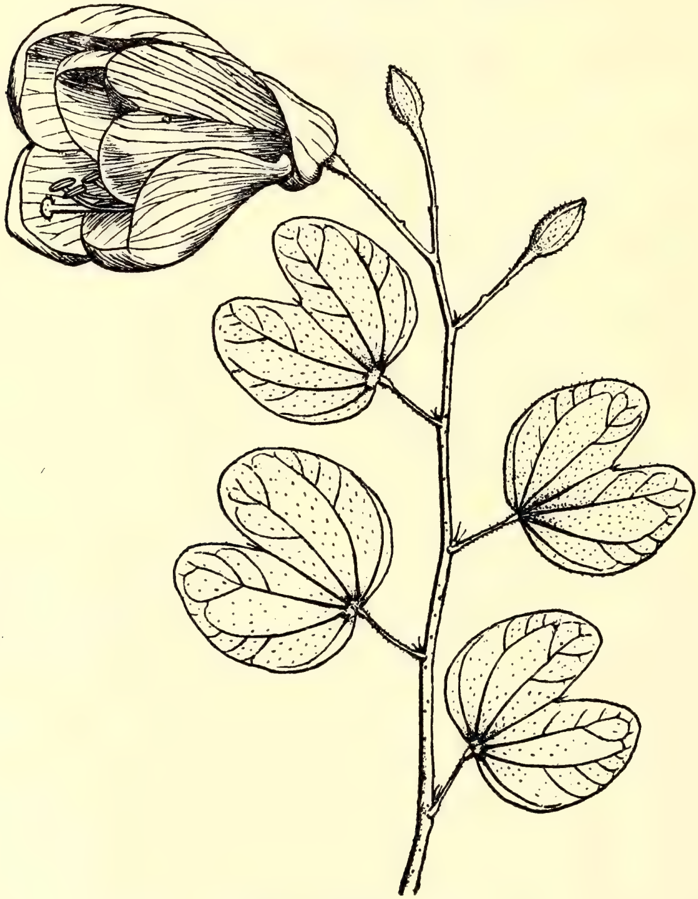

Fig. 2.—*Bauhinia tomentosa* Linn. × 1/1.

Description.—A handsome shrub which sometimes grows into a small tree. Leaves compound, on slender petioles up to 1 in. long, stipulate; stipules long, subulate, hairy. Leaf-blade of two

Photo by *M. N. Bakshi*

Bauhinia acuminata Linn.

connate leaflets, coriaceous, 1-2 in. long, broader than long, 7-9-nerved from the base, glabrous on the upper surface, tomentose below, 2-lobed; lobes rounded at the apex; reticulation conspicuous.

Flowers axillary in pairs (sometimes 1 or 3) on pedicels bearing a pair of subulate persistent bracteoles. Calyx tube short, covered with appressed pubescence; limb spathe-like with 2 small teeth at the apex in bud, splitting down one side when the flower opens, about .5 in. long. Corolla of 5 distinct petals. Petals obovate in shape, .75-2 in. long, not clawed, yellow in colour, conspicuously veined, one with a red blotch on the inner surface. Stamens 10 in number arising from the lip of the calyx tube; anthers sagittate. Ovary on a gynophore; style nearly .75 in. long. Pod dehiscent, stalked, 4-5 in. long, 6-10-seeded, tomentose or glabrous.

Flowers.—August-Oct. *Fruits.*—Dec.-Feb.

Distribution.—Throughout India, wild or cultivated, extending to China and tropical Africa. Now commonly cultivated in the tropics of both the old and the new worlds.

Gardening.—A handsome shrub. New foliage and young parts downy brown. Flowers sulphur-yellow, drooping. Easily raised from seed sown in April. This shrub is partially deciduous in Dehra. According to J. D. Hooker it was introduced to the Royal Gardens, Kew, in 1860.

Medicinal and economic uses.—The wood of this species is tough and the heartwood black. It was formerly used in Java for the handles and sheaths of krises (Burkill).

The bark, root and leaves are said to be efficacious as poultices for boils. The plant is also said to be anti-dysenteric, anthelmintic and of value in liver complaints.

Bauhinia acuminata Linn.

(*acuminata* is a Latin word meaning sharp pointed, and refers to the lobes of the leaf).

Description.—An erect shrub with reddish-brown branches covered with minute hairs. Leaves alternate, stipulate; stipules lanceolate-subulate, covered with short hairs. Petioles 1-1.5 in. long, swollen at the base and apex, downy. Compound leaf-blade 9-11-nerved from the base, the common midrib being produced as a very short spur, orbicular in shape, acuminately 2-lobed, thinly coriaceous in texture, glabrous above, pubescent on the nerves beneath, 3-6 in. long.

Flowers a pure white, close, shortly peduncled, in axillary, corymbose racemes. Calyx tube about .3 in. long; limb spathe-like up to 1.5 in. long in the bud, ending above in 5 short subulate hairy lobes. As the flower opens the calyx splits along one side, becomes reflexed and eventually divides into five segments below. Petals 2 in. long, .75 in. wide, oblong-obtuse, white, not clawed but rounded at the base, seated on the margin of the calyx tube. Stamens 10, filaments white, of various lengths; anthers yellow, versatile, hairy. Ovary on a gynophore at the base of the calyx tube. Style short, .5 in. long; stigma a 2-lobed disk. Pod pendent

from a .5 in. stalk, 4-5 in. long, .9 in. broad, firm, glabrous, 8-12-seeded, with a rib on each side of the upper suture.

Fig. 3.—*Bauhinia acuminata* Linn. × 2/3.

Flowers.—March-May. *Fruits.*—Cold season.

Distribution.—Indigenous to Central India, Ceylon, Malaya and China. Very frequently cultivated in gardens all over the country.

Gardening.—This is one of the most satisfactory species of *Bauhinia* for cultivation in the open. It is quite frost hardy and starts flowering when the plants are only a few months old and but a foot or so high. According to Aiton's 'Hortus Kewensis' it was introduced from India into England by Dr. Francis Russell and flowered at Kew in the month of May and June. It grows readily from seed and bears its numerous, large, snow-white flowers practically all the year round but chiefly during March-May.

Photo by *M. N. Bakshi*

Galpin's Bauhinia.

Bauhinia Galpini N. E. Brown.

Galpin's Bauhinia.

(This plant was named in honour of E. E. Galpin, who was one of the earliest collectors of the species).

Description.—A rambling prostrate shrub with hairy stems. Leaves alternate, stipulate, consisting of two leaflets connate by their inner margins, with the common midrib produced as a minute spur, obtusely 2-lobed, 7-nerved, broader than long, up to 3 in. broad, minutely pubescent with white hairs on the lower surface; margins and under surface thickly or sparsely covered with yellow glandular exudations; petiole about .5 in. long.

Flowers brick-red or crimson in colour, borne in 2-10-flowered axillary racemes. Peduncles very short. Calyx tube up to 1 in. long, rather stout, somewhat striate, dark red in colour, sparsely covered with yellowish glandular exudations. Calyx limb at first spathe-like, reddish but appearing to be striped with yellow from the production of a glandular yellow substance, becoming reflexed after the flower opens and splitting down one side, subsequently dividing into 5 segments at the base which remain connate at the top. Petals 5, inserted at the top of the calyx tube, 1-1.5 in. long, clawed, the claw being as long as the limb. Limb orbicular in shape, cuspidate, rather undulate on the margins. The inner surface of the petals is clear red, the outer surface being dotted all over with yellow particles. Stamens 3 in number, inserted at the top of the calyx tube, together with seven very short, subulate staminodes. Filaments red, anthers versatile. Ovary linear, seated on a gynophore 3 in. long, covered with short white hairs and yellow glandular exudations. Style thick; stigma globose. Pod 3-5 in. long; seeds dark brown.

This plant will often be found to be covered with ants which come to feed upon the yellowish product of the glands.

Flowers.—Sept.-Oct. *Fruits.*—Cold season.

Distribution.—Indigenous to the Transvaal and adjacent tropical Africa; commonly cultivated in gardens in the plains throughout India.

Gardening.—This fine species, which in its native country is said to be a climber is found only as a straggling or prostrate shrub in India. It thrives better on a well-drained soil and bears its bright scarlet flowers profusely during Sept.-Oct. Propagated by seed which germinates rather sparingly. The seedlings are liable to damp off during the rains if not properly looked after. This beautiful shrub is well worth growing in spite of the initial difficulties of propagation.

Bauhinia anguina Roxb.

Snake Climber.

(*anguina* means snake-like and refers to the peculiar stems of this species).

Description.—A woody cirrhose climber with very peculiar compressed flattish stems, alternately concave and convex in the central

portion, with stout margins. This is an adaptation to take strain. The majority of the sap vessels are in the corrugated part so that if tension is applied the strain is taken by the margins and

Fig. 4.—*Bauhinia anguina* Roxb. × 2/3.

the ascent of sap is not impaired. Leaves alternate, densely tomentose when young, glabrous when old, thin, 2-5 in. long, shortly lobed or with 2 very long acuminate lobes. On old plants the leaves are often quite entire and acuminate.

The flowers are very small for the genus and are arranged racemosely in lax, pubescent, terminal panicles. Individual flowers seated on very short pedicels. Calyx very small about .05 in. long, broadly campanulate, with 5 deltoid teeth. Petals 5, oblong-lanceolate in shape, about .1 in. long. Fertile stamens 3. Pod thin flat, oblong or elliptic, glabrous, indehiscent, 1.5-2 in. long, 1-2 seeded.

Flowers and fruits.—Cold season.

Distribution.—Sikkim Tarai, ascending to 2,000 ft., Khasi hills, Chittagong, Martban, Malabar and Travancore.

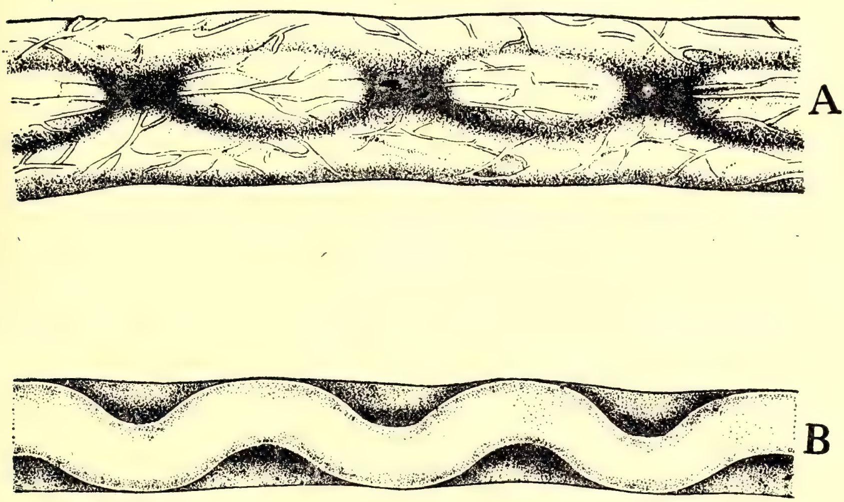

Fig. 5.—Stem of *Bauhinia anguina* Roxb.

A.—A surface view of the strap-shaped stem.
B.—A longitudinal section of the stem seen sideways to show the sinuous centre portion.

Gardening.—A large evergreen climber having a curious stem and small inconspicuous white flowers. According to Roxburgh 'the most regularly serpentine pieces of the stems and large branches are carried about by our numerous mendicants to keep off serpents'. Easily propagated by seed or layers.

Bauhinia Vahlii W. & A.

Camel's foot Climber.

(This species was called after Martin Vahl, a Danish botanist, 1749-1804).

Description.—A gigantic climber, with densely pubescent branches and abundant circinate tendrils, mostly leaf-opposed. Leaves compound, alternate, petiolate, deeply cordate at the base, lobed at the top, 11-15-nerved from the base, almost orbicular in shape,

up to 18 in. long, sparsely hairy on the upper surface, densely ferrugineous-tomentose on the lower surface; petiole 3 in. long.

Fig. 6.—*Bauhinia Vahlii* W. & A. × 2/3.

Flowers numerous, arranged in long-peduncled, terminal, dense, subcorymbose racemes. Individual flowers seated on pedicels 1-2.5 in. long, with persistent bracteoles at the base. The whole inflorescence is covered with a dense rusty tomentum. Calyx tube short, it and the limb very hairy; limb splitting into 3-5 valvate segments when the flowers open and becoming reflexed. Petals 5, white fading to yellow, shortly clawed, broadly spathulate in shape, spreading, glabrous within, covered on the outside with rusty villae. Stamens 3, fertile; a number of staminodes may be found on the lip of the calyx tube. Ovary on a short gynophore, very densely hairy as is also the style. Pod woody, up to 12 in. long finally dehiscent, velvety, 8-12-seeded.

Flowers.—April-June. *Fruits.*—Cold season.

Distribution.—Subhimalayan tract and outer valleys ascending to 3,000 ft. from the Chenab eastwards, chiefly in sal forests; Assam, Bihar, Western Peninsula.

Gardening.—This gigantic woody climber needs plenty of space for its growth. It is useful for covering unsightly embankments and the like. Easily raised from seed. It is one of the most distinctive climbers in the Indian forests. The trunk may reach a girth of 4 feet and is often deeply fluted. When cut down shoots more

Photo by *M. N. Bakshi*

Bauhinia corymbosa Roxb.
New Forest, Dehra Dun.

than 50 feet long may be produced in one season, and for this reason it is difficult to eradicate this plant which is considered a pest by forest officers.

It is known as Camel's foot Climber as the leaves are very much the size and shape of a camel's footprint.

Medicinal and economic uses.—The large leaves are used as plates by the local inhabitants, who also value the seeds as a source of food. To extract the seeds the pods are placed in the fire. The bark yields a strong fibre which is used for making ropes. The stem produces a valuable tanning material. The seeds are said to possess tonic and aphrodisiac qualities.

Bauhinia corymbosa Roxb.

(*corymbosa* refers to the arrangement of flowers in the inflorescence which are described as corymbose, but in Dehra they are decidedly racemose).

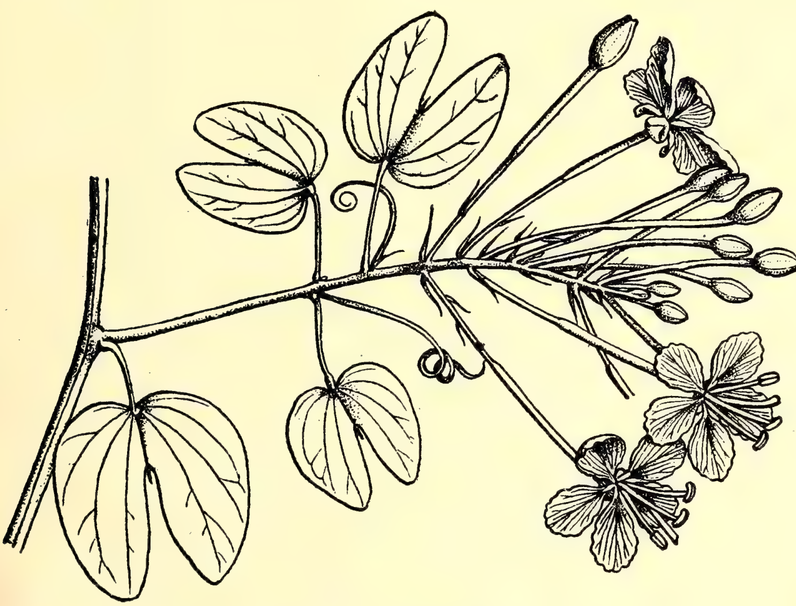

Fig. 7.—*Bauhinia corymbosa* Roxb. × 1/1.

Description.—A woody climber, branching from the ground, with grooved branches and circinate tendrils. Leaves compound, 1-2 in. long, divided almost to the base; common midrib very short, produced into a short spur; lobes rounded. The two leaflets fold together at night. Petiole up to 1 in. long, swollen at base and apex, often covered with appressed brownish hairs.

The fragrant flowers are borne in terminal long-peduncled racemes or corymbs. The individual flowers are seated on pedicels up to 1 in. long and are supported by bracts and bracteoles. The calyx tube is .75 in. long, green in colour, with 10 well-marked red ribs covered

with brownish hairs. Calyx-limb short, .25 in. long, red, 5-lobed; lobes valvate, splitting into 5 segments, which turn downwards as the flower opens. Petals white, with pink nervation, rather crumpled, seated on the margins of the calyx tube. Fertile stamens 3, on pink filaments, posterior; staminodes 5, pink, anterior, all seated on the calyx tube. Ovary on a gynophore arising from the calyx tube, red in colour, produced into a short style and globose stigma. Pod 4-5 in. long, .7 in. broad, thin, smooth, dark brown.

Flowers.—April-June. *Fruits.*—Cold season.

Distribution.— Native of China. Commonly cultivated in gardens throughout India.

Gardening.—*Bauhinia corymbosa* is one of the most beautiful of climbing Bauhinias; and even with its rather small flowers, it is a most charming plant with exceedingly slender stems and very small, pretty, dark green shiny foliage. The rosy-white, fragrant flowers appear in great abundance during April-June. Easily raised by layers. It has long been cultivated in Indian gardens for its ornamental foliage alone.

THE POMEGRANATE.

BY

J. F. Caius, s.j., f.l.s.

Alphonse de Candolle sums up the results of his painstaking investigation into the origin and distribution of the pomegranate (*Punica Granatum* Linn., the sole genus with only two species within the family *Punicaceae*) as follows:—

'To conclude, botanical, historical, and philological data agree in showing that the modern species is a native of Persia and some adjacent countries. Its cultivation began in prehistoric times, and its early extension, first towards the west, and afterwards into China, has caused its naturalization in cases which may give rise to errors as to its true origin, for they are frequent, ancient, and enduring.'

In fact, many of these errors, if errors they be, are being perpetuated with effusion of much good ink and not a little bad blood. But there is no apparent reason why the question should ever be satisfactorily settled, because the pomegranate has been so long under cultivation that it is impossible to say with any degree of certainty whether the plant is really native in any particular region.

The antiquity of the tree as a cultivated plant is evidenced by the references to the fruit in the Old Testament—

'Why have you made us come up out of Egypt, and have brought us into this wretched place, which cannot be sowed, nor bringeth forth figs, nor vines, nor pomegranates . . . '—.

and in the Odyssey where it is spoken of as cultivated in the gardens of the kings of Phaeacia and Phrygia. In the villa garden of king Amenhotpou IV, of the Eighteenth Dynasty, may be seen painted on the wall of a tomb at Tell-el-Amarna, ten pomegranate trees easily recognizable from the shape of the fruits and the leaves. The fruit is, indeed, frequently represented in ancient Assyrian and Egyptian sculptures, and it figures prominently among the offerings made to the gods by Ramses IV, a Pharaoh of the Twentieth Dynasty. As a design it has been used in architecture and needlework from the earliest times. It formed part of the decoration of the pillars of King Solomon's Temple, and was embroidered on the hem of the High-Priest's ephod. It had a religious significance in connection with several Oriental cults, especially the Phrygian cult of Cybele, and it is still used by the Jews in some ceremonials.

The pomegranate was well known to the Greeks and Romans, who were acquainted with its medicinal properties and its use as a tanning material. The name given by the Romans, *malus punica* or *malum punicum,* indicates that they received it from Carthage, as indeed is expressly stated by Pliny—'but the territorie of Carthage challengeth to itself the punicke apple' (Holland)—; and this circumstance has given rise to the notion that the tree was indigenous in northern Africa.

The pomegranate-tree was introduced into India from Persia or Afghanistan, presumably in the first centuries of our era. The tree is not mentioned in Vedic, Pāli, or early Sanskrit literature; and the word *dālima* or *dāḍima* is traceable to the Iranian *dulim,* as reconstructed by Berthold Laufer[1] on the basis of the Chinese transcription. According to the Agnipurana 'dadima' is to be planted in the garden adjoining one's house; and, on the authority of the Brihat-samhita, it is to be propagated by means of cuttings besmeared with cowdung. Varahamihira mentions the pomegranate as one of the trees growing in the Anupa region, Susruta gives it as one of the plants which act as cordials and increase the appetite, and Charaka recommends it for the wholesomeness of its fruit.

Characteristics.

The pomegranate is a large deciduous shrub or small tree. As a tree it rises to a height of fifteen to twenty feet; it is covered with a desquamating greyish or pale brownish bark, and is divided into many slender, twiggy, nearly cylindrical branches, which are armed with spines. The buds and young shoots are red.

The leaves are opposite, or ternate, about three inches long, sessile, wavy, entire, oblong or lance-shaped, pointed at both ends, glossy green and with red veins.

The flowers are large, raised on a short stalk, of a rich scarlet colour, solitary, or in twos or threes or fives at the extremities of the young branches. The calyx is turbinate, thick, fleshy, of a fine red colour, and divided into five acute segments, which are valvate in aestivation. The corolla is composed of five, or seven, large roundish crumpled petals, inserted on the throat of the calyx alternate with the sepals, rather spreading, and of a bright scarlet colour. The stamens are indefinite, many-seriate, perigynous, inserted at different levels below the petals; the filaments are capillary and free, furnished with ovoid yellow anthers, 2-celled, dorsifixed, and bursting in front by two chinks. The ovary is inferior, roundish, many-celled, with a slender simple style—the length of the stamens, and capitate papulose stigma.

The fruit is as big as a common orange, and not unfrequently much larger. It is globular, somewhat compressed, obscurely six-sided, and indehiscent. It contains numerous oblong or obconical, many-sided exalbuminous seeds, each enveloped in a distinct very juicy rose-coloured pulp enclosed in a thin skin, so that the inside of the pomegranate appears to be made up of a large number of reddish berries packed tightly together. The rind, which is the calycine tube, is smooth, hard, leathery and, when the fruit is ripe, of a brownish yellow tint, often finely shaded with red. The interior is divided into two chambers by some six spurious transverse membranous dissepiments meeting in the axis of the fruit. The upper chamber is 5- or 9-celled, the lower 3-celled. The placentas

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[1] Sino-Iranica. *Chicago Field Museum of Natural History,* publication 201; Anthropological Series, Vol. xv, No. 3.

of the upper division reach from the walls to the centre; those of the lower proceed irregularly from the bottom of the fruit.

The embryo is oblong with a short straight radicle, and foliaceous, spirally convolute cotyledons.

As a botanical entity the pomegranate has been placed by various authorities in different orders wherein, for want of close relations, it has always occupied an anomalous position. Though nearly allied to the myrtles it differs from them in the absence of aromatic principles in the green parts, in the absence of dark dots and marginal veins in the leaves, and in the typical conformation of the fruit. It is chiefly owing to the singular structure of its fruit, a *balausta,* that the genus *Punica* has finally been formed into a separate order, *Punicaceae.*

The family consists of only one genus with two species: *P. Granatum* Linn. (=*P. florida* Salisb., *P. grandiflora* Hort., *P. nana* Linn., *P. spinosa* Lam.), and *P. protopunica* Balf. discovered by Balfour in the island of Socotra.

CULTIVATION.

The pomegranate is a favourite in the East, and is grown both for its beautiful flowers and for its edible fruits. It is not particular as to soil, though it enjoys a deep calcareous ground and prefers a dry situation to one that is surcharged with wet. Native gardeners in India recommend that the soil be mixed with a large proportion of bricks broken fine, together with old, decayed cowdung.

The trees may be planted eight or ten feet apart, and the ground cultivated with irrigated crops until the trees occupy the soil. They can also be grown as a hedge. They are usually raised from seed, but are also multiplied by hardwood and softwood cuttings, or by layers. As the plant forms many shoots, these are often used, as they are usually provided with rootlets. For latitudes higher than the 35th degree North, the plant ought to be cultivated in tubs, and given a conservatory during winter.[1]

Under cultivation there are several forms differing more or less in the colour of the flowers, both single and double, and only of ornamental value. The double-flowered varieties are specially desirable for the beauty and long duration of their flowers. The better known are: *double red,* with a very large calyx, from which protrude numerous large bright scarlet petals, larger than those of the common single type, which give the flower the appearance of a bright scarlet pompon; *double dwarf,* specially desirable for growing in pots, with bright scarlet flowers borne in clusters; *double variegated,* with very large flowers, the petals being striped and mottled with yellow and scarlet—as this is a sport of the Double Red it frequently reverts to type, and consequently double red blooms are often to be found on the same stem with variegated blooms; *double yellow,* similar to the Double Variegated in the shape of the flower; *double white,* with a pure white flower similar in shape to Double Red.

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[1] L. H. Bailey.—The Standard Cyclopedia of Horticulture; 1916.

Although of such ancient origin and cultivation, there are but few varieties of fruit-bearing trees, and the various kinds of pomegranate may be reduced to three: one very sour, the other two moderately sweet or very sweet. The distinction between a sweet and a sour pomegranate is already made by Theophrastus and, though Pliny distinguishes five varieties—*dulcia, acria, mixta, acida, vinosa*—, ancient authors discriminate between only two.

The emperor Jahangir mentions in his Memoirs the sweet pomegranates of Yazd and the subacid ones of Farrah, and says of the former that they are celebrated all over the world. Crawford remarks in his History of the Indian Archipelago: 'The only good pomegranates which, indeed, I have ever met with are those brought into upper India by the caravans from eastern Persia.' And Firminger[1] states: 'The Pomegranate tree is common in all parts of India, but never produces fruit at all to be compared with that brought down annually by the Afghan traders from Kabul.'

The seedless pomegranates so highly prized by Akbar's household came from Kabul; and the sweet, pure, and full-flavoured pomegranates with white and very transparent seeds were from Baluchistan. In course of time the seeds of these high class fruits found their way from Afghanistan to Bengal, where there is made mention of several fine varieties of local growth: seedless[2], very sweet, deliciously perfumed, the size of an ordinary human head or as large as a small shaddock.

'A tree that bears fruit of good flavour with as few seeds as possible should be grafted on seedlings, and none but the grafted plants grown. Such trees need no more manure, water, or land than common seedlings, yet the value of their fruit is very great in comparison.' Woodrow's[3] recommendation to graft from trees of a superior kind is sound, but not all superior varieties will thrive away from their natural surroundings. Thus, says Burns, the Kabul Pomegranate, both in its own roots and when grafted on Poona stocks, has done very badly in Poona, making little growth and producing few fruits.

In North America, where pomegranates are grown commercially in several of the southern states, the following varieties are cultivated for fruit:—

Acid or *Wild*—with a sharp acid pulp; fruit often very large, from 3 to 4 inches diameter and with a bright-coloured rind.

Dwarf—a form of the Acid variety, of very low and bushy growth; flowers single; fruit from 1½ to 2 inches diameter; pulp very acid. This can be grown in a pot, as it fruits very abundantly.

Paper Shell—very large, juicy, very sweet, and of excellent quality; skin thin, pale yellow with crimson cheek; sides crimson; fine grower, good bearer, and ships well.

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[1] W. Burns.—Firminger's Manual of Gardening for India, 1918.

[2] 'I do not know any seedless variety is growing in Bengal.' (N. Mitra, Curator, Royal Botanic Garden, Shibpur; 5th December 1939).

[3] G. M. Woodrow.—Gardening in India, 1889.

Rhoda—fruit crimson, of large size; skin thin but tough; crisp, sweet, and of exquisite flavour.

Spanish Ruby or *Purple-seeded*—is cultivated in Louisiana, seems to be only a form of the subacid. Fruit large and bright-coloured with deep crimson pulp. It is considered the best of its class.

Subacid—differs only from the sweet in the more acidulated pulp.

Sweet—fruit usually somewhat smaller than the Acid and with a darker-coloured rind; pulp sweet.

Wonderful—said to be the largest of all pomegranates; fruit sometimes 5 inches in diameter, bright crimson; pulp highly coloured; very juicy; fine flavour; ripens early; good shipper.

All these varieties are very ornamental from their abundant yield of bright scarlet flowers, which are produced upon the extremities of the young branches of the same year's growth. When the plant is grown in a tree form, the branches should be annually cut back after the leaves drop.

A great many shoots spring from the base of the plant; these should from time to time be cut clean out, as it is contended that they withdraw the nutriment which should go to the fruit-bearing stems. To yield fine fruit the plant must be manured each year.

Writing about 'Tropical and Subtropical Fruits in California,' F. W. Popescoe notes[1].—'The Pomegranate is produced commercially in a small way, the demand for the fruit being limited. The shrub succeeds best, and is most commonly grown, in the interior valleys. The inferiority of the varieties cultivated in the State has led to an attempt to secure superior ones; among those which have been introduced the variety 'Wonderful' has proved to be choice, and is now offered by the trade.'

Pomegranate ripening fruit on a wall at Trewarthenic, Tregony, was reported[2] as one of the effects of the fine summer of 1911. And in 1912, R. Irwin Lynch wrote[3]:—'I have seen this [*Punica Granatum,* North Africa, West Asia] fruiting on the side of a house in East Cornwall; it has fruited at Henley-on-Thames, and should fruit generally without much assistance. The double form flowers on my house at Cambridge, and for some years a stool of it grew in the open, quite without protection, dying down in winter and coming up in spring like a Fuchsia.'

The longevity of the tree is said to be remarkable.

Cultivation in India.

In India the Pomegranate is cultivated in various places: North Kanara, Bijapur, Sholapur, Satara, Poona, Ahmednagar, Ahmedabad, Sind, Baluchistan, Muzaffargarh, Delhi, and Jodhpur.

Bombay.—In the Bombay Province about 2,000 acres are under pomegranate. More than half the area is claimed by the Poona district, where most is grown in the Haveli, Bhimthadi and Purandhar talukas. The Dholka taluka of the Ahmedabad district

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[1] *Journal of the Royal Horticultural Society;* xxxix, part II, 1913.
[2] *Ibid.;* xxxviii, part I, 1912.
[3] *Ibid.;* xxxviii, part II, 1912.

claims 15 per cent. of the total area in the Bombay Presidency. The Ahmednagar district grows about 15 per cent., mostly in the Pathardi, Rahuri, Ahmednagar, and Sangamner talukas. Except in a few places like the Dholka taluka, and a few villages in the Poona district, the fruit is not of a superior quality.

1. *Sangamner*[1].—Pomegranates require a porous soil containing much lime; and generally farmers choose such soil. Sound and big fruits are selected for seeds. These fruits are kept longer than usual on the tree, and are plucked only when they begin to rot; they are then allowed to rot still further; the seeds are taken out, well mixed with ashes, and dried in the shade.

A plot, about two or three gunthas in area, near a well is ploughed and dug out deeply down to 1 foot. The soil is made fine by breaking clods, and about a cartload of farmyard manure and household ashes is mixed with it. The seeds are then thinly broadcasted in *walas* about one hundred feet square. The seed is covered, and the plot is watered on the same day. The second watering is given on the sixth day, and then further waterings once in ten or twelve days as required. No weeds are allowed to grow in the plot.

Generally the seedlings are transplanted in the early part of the monsoon, when six or twelve or even eighteen months old. The field into which the seedlings are to be transplanted is twice ploughed and harrowed, and the soil is mixed with about ten or twelve cartloads of farmyard manure. This ploughing and manuring is done to prepare the ground to receive onions, garlic, chillies, or any other plant which may be grown without injury to the young pomegranate. These sub-crops are cultivated during the first two or three years, that is up to the time when the fruit plants cover the ground and begin to yield.

Pits, about eighteen inches square and two feet deep, are then dug out. The distance between two pits cross-wise as well as length-wise varies from twelve to fifteen feet. In one acre about two to three hundred plants can easily be grown this way. Of late, however, some farmers have reduced the distance between the pits to ten feet.

The earth that is dug out of the pits is separated into two portions, the upper layer being kept apart from the lower one. The earth of the upper layer, which is well weathered and contains ready plant food, is put first in the pits; it is then covered with a basketful of farmyard manure. When the plant has been fixed in the pit the earth from the lower layer mixed with household ashes is thrown over the manure. About a cartload of ash is sufficient for one acre of land.

Ring-like bands of three to five feet in diameter are then made round the plants and moderately filled with water. A second watering is given on the fourth or fifth day, and afterwards once in a week or ten days according to the season.

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[1] Mirza Niazbeg—Pomegranate Cultivation at Sangamner. *The Poona Agricultural College Magazine;* March 1914.

The pomegranate plants begin to flower when they are three years old; but this first flowering brings very little fruit, and it is not until the fourth year that the garden is earnestly taken in hand. During those first four years the plants are manured once a year with farmyard manure and whenever possible, with fish manure also. The ringed area is dug out once in three months to give a better circulation of air. No weeds are allowed to grow. In the fourth year the rings are widened up to eight feet in diameter.

Pomegranate plants flower thrice a year :—in February or March, *ambe-bahar;* in June, *mrig-bahar;* and in September, *hatti-bahar.* Five or six months after the flowering the fruit is ready for marketing.

Except for the time of the first watering, which varies with every *bahar,* the routine is always the same. Let us take, for example, the *mrig-bahar,* since preference is generally given to it by the farmers for reasons of economy, the cost of watering being very much lessened on account of the rainy season. In April the ringed portion is dug out and the roots in the upper layer are exposed to the air for a week or two—the leaves that fall off are often used as manure for the same plants. A basketful of farmyard manure is given to each tree, and if fish manure is available a handful of it per plant is given in addition to the farmyard manure. The manure is thoroughly mixed with the soil. The first watering is given in *Akshattritiya,* which is generally in May, and further waterings are given once in a fortnight. Flowers appear one month after the first watering. When the ovary is developed and fruits as big as small lemons are formed the ringed portion is lightly dug out every month before watering.

Each plant bears about forty fruits in the first year, and each year the number increases even up to four hundred when the tree is fully grown up. If good care is taken of them the trees bear fruit up to from twelve to fifteen years. When a plant does not bear a sufficient number of fruits it is pruned leaving the stem only from six to twelve inches above the ground. The cut surface is plastered with cowdung, and the plant is heavily manured and watered. New shoots come out and grow into trees which bear fruit for another ten years.

Generally the garden is rented to *Bagwans* who pay Re. 1 to Rs. 1-4 per plant. The Bagwan takes care of the garden, but the farmer supplies him with water for irrigation. As a rule the Bagwan makes a net profit of Rs. 200 on one acre. His expenses are Rs. 150, and he pays Rs. 250 to the owner. So the gross income on one acre of land is Rs. 600.

2. *Ganeshkhind.*[1]—Seven varieties of pomegranate were under trial from the year 1905. Three of these were local, two from Sangamner, and two foreign (Kabul and Muscat). All were grown from seeds of specially selected fruits. The foreign varieties made

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[1] S. H. Prayag—The Ganeshkhind Botanical Garden, Kirkee. Its genesis and development. *Department of Agriculture, Bombay;* Bulletin No. 104 of 1920.

poor and stunted growths, and failed to bear fruit even after eight years' growth. Grafts of Kabul variety on local stocks also failed to fruit even after seven years' growth. The following trials were conducted for nearly four years:—(i) The comparison of different methods of irrigation, viz., Basin, Trench, and Ring systems. The trench system proved to be unsatisfactory as the trees began to show signs of drought, reacting on the yield, which was consequently very low. The ring method showed the advantages of economy in the amount of water given and the avoidance of any rot of the stem at the collar.—(ii) Comparison of grassed and cultivated lines of fruit trees. In this experiment the weeds as they grew were cut and kept as a mulch three to four times during the year. The difference between the two plots was not appreciable.

3. *Gokak.*[1]—As evidenced from the growth of the plants and the quality of the fruits in one of the gardens at Gokak a limy or phosphatic soil seems to suit the pomegranate very well. Medium black soil with murum as sub-soil is fairly suitable, but black soil is no good.

Before digging the pits the land is well ploughed, harrowed and clod-crushed, and the soil brought to a fine state of tilth. The pits are 3 ft. deep and 3 ft. square, and the distance between them is 13 to 14 ft. each way. To economize space the hexagonal system based on equilateral triangles is adopted, whereby all adjacent trees are equally distant from each other. The pits are dug in the summer months of April and May so that the earth, both in and out, may be thoroughly exposed to the action of the daily hot air for a space of two or three months. When the pits are to be filled up bone meal, if available, is spread at the bottom; this is then covered with the surface portion of the excavated earth; and this in its turn is covered with the bottom soil, if not too bad. When the bottom soil is too bad it is rejected, and good soil or fine silt brought from outside.

Seedlings one year old are the best for planting; others take more time to establish themselves. July-August is the proper time for planting, preferably late in the afternoon. The ideal conditions are a cool weather and light drizzling rains. The pits are watered one or two days before planting. When the young plant has been firmly fixed a small basin is made to hold the requisite quantity of water. At first the plant is watered lightly every day in the evening or at least once in two days. After the appearance of fresh sprouts the watering is given only twice a week for some time, and then gradually the interval is increased to once in a week or ten or even twelve days.

After the seedlings have established themselves two or three handfuls of farmyard manure may be given. Three or four days after each watering, the basins are kept loose by stirring and all the weeds are removed. When the plants are one year old they

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[1] I. S. Kulkarni—Notes on the cultivation of Pomegranates as experienced on the Gokak Canal Farm. *The Poona Agricultural College Magazine;* January 1920.

are manured with about half a basketful or 10 lbs. of farmyard manure per plant. In the second and third years, twice as much manure is applied. No further care need be taken except pruning, weeding, and watering at intervals, the interval varying with the nature of the soil and the time of the year. If the soil is good and if proper care is taken the plants will become fit for bearing even as early as the third year.

For the first three years intercrops such as onion, garlic, groundnut, gram, chilly, cabbage, pea, tomato, brinjal, knolkol may be grown; and the net income accruing from these will more than make up for the initial and the running expenditures involved in the cultivation of the pomegranates during the early stages.

The flowering periods are (i) January-February, *ambebahar;* (ii) June-July, *mrigbahar;* and (iii) August-September, *hastabahar.* On this farm the period selected for treatment is either *ambebahar* or *mrigbahar,* preferably the former when the plants are less subject to attacks from insect and fungus pests. Watering is stopped two months before the time of flowering; one month after, the roots are exposed and the branches pruned; then the roots are covered again, the beds renewed, and the plants manured and watered. It takes from four to five months for the fruits to ripen. When the fruiting season is over all flower-buds, flowers, and stray fruits are removed and the trees left to themselves till the next year's treatment.

At Gokak the pomegranate is propagated from seeds. The fruit is allowed to ripen completely on the tree and to fall down to the ground of itself; it is then picked up and kept for some time to allow rotting. Then the seeds are squeezed out, mixed with earth or ashes and kept ready for sowing.

SIND[1].—Shikarpur is famous as a centre for fruit-growing. There are altogether some 150 orchards, with an area of 868 acres, of which 139 are under pomegranate.

With the advent of spring, mature branches are pruned out and cut in pieces nine to twelve inches long. These cuttings are buried two-thirds deep in the soil of the nursery bed, and their tops are covered with fresh cowdung. The beds are irrigated at intervals of three to four days, till the cuttings have sprouted, which they usually do in about a month's time. The cuttings stand in the nursery bed for full two years, during which period they receive hoeings once a month regularly. They are planted in rows nine to twelve inches apart. This is by no means too close a planting because, while there are always some cuttings which do not germinate, the white ants do a good deal of thinning work. The cuttings are raised in gardens for sale and fetch Rs. 2-8-0 to Rs. 3 per hundred.

The field operations begin during the inundation season. The plantation is irrigated, ploughed twice, levelled, and laid out in small

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[1] Mahomed Umarkhan F. Barokzai.—Fruit Culture as practised near Shikarpur, Sind. *Department of Agriculture, Bombay;* Bulletin No. 98 of 1920.

plots measuring from one quarter to one half of an acre each. Parallel channels or furrows, twelve inches by eighteen inches, are made twelve feet apart. Along each channel, but on one side of it only, circular holes are dug at a distance of twelve feet. After an exposure of a week to ten days, the excavated earth is mixed with fifty pounds of cattle manure and returned to the pits. The plants to be used are carefully lifted from the nursery beds and carried to the field some time about the 11th March, at the *Mahashivaratra.*

Irrigation during the first few months after the transplantation is given about twice a week, but when the plants are fairly established watering is limited to once a week throughout the year. In case of white ants proving a serious pest, the interval is shortened to suppress the attack.

For the first three years the soil round the plants is stirred and weeds removed twice a month. The channels are also cleaned in order to grow sub-crops: brinjals, chillies, karela (*Momordica Charantia*), turi (*Luffa acutangula*), bhindi (*Hibiscus esculentus*), chuka (*Rumex acetosa*), methi (*Trigonella Faenum-graecum*), etc. With the fourth year, when the fruit plants cover the ground and begin to yield, the weedings cease altogether and the growth of natural grasses is encouraged as these provide an excellent green feed for cattle and consequently are readily sold. Cattle, camel, and horse owners purchase standing crops of weeds for the season. The weeds commonly found in pomegranate and other fruit plantations are dubh (*Eragrostis cynosurioides*), gandheer (*Eleusine flagellifera*), chhabar (*Cynodon Dactylon*), savri (*Panicum Colonum*), kabah (*Cyperus rotundus*), lulur (*Digera arvensis*), and dinuhi (*Andropogon annulatus*).

Pruning of dead branches on the top and fresh growth at the roots of full-grown plants is effected in November. Manure is applied once a year in February when the trees are leafless; one *jholi* (cloth load) of manure weighing about thirty pounds is applied to every two plants. This costs about two annas. Before applying manure, the soil round the roots is dug out and replaced by fresh canal earth.

The pomegranate has two flowering seasons, the first commencing from early *Phalgun* (March to April), and the second from *Bhadra* (September to October). The fruit of the former lasts till the *Dassera* (October) festival, and that of the latter till *Margashirsh* (January-February). Of these two seasons the Phalgun flowering is always the better. In addition to these distinct flowering seasons the plant is said to put on all the year round one or two flowers locally termed the *Chorgul* (thief flower).

From the fifth to the fiftieth year of their age the trees produce excellent yields. The average number of fruits per plant is 70, the range being from 40 to 100, each weighing from half to three quarters of a pound. This gives an average yield of 30 pounds per tree, the maximum amounting to as much as a maund (80 lbs.) of fresh fruit. Calculating at the average price of Rs. 4-8-0 per maund, each plant produces Rs. 1-11-0 on the average, and each acre of about 250 plants returns roughly Rs. 420.

Another product of the trees is the quantity of fallen flowers obtained from the *Phalgun* flowering. These are gathered, dried, and sold at Rs. 4 per maund of 80 lbs. Ten to twelve maunds are collected per acre fetching from Rs. 40 to Rs. 50.

The third product consists of the rotten fruits which have been damaged by insects or by birds. The seeds are dried and sold as *khat* (sour substance used in curries), while the rind goes to the dyer to yield a yellow dye. The quantity collected is not large but, nevertheless from Rs. 10 to Rs. 15 per acre are usually obtained.

There are twelve varieties of pomegranate commonly grown in the locality: *bedaho, kandhari, vanga, chiho, sona, dandan, multani chiho, sehwani, green sehwani, sindi sehwani, jesalmeri, sindi jesalmeri.* Of these *sehwani, kandhari, sindi sehwani, sindi jesalmeri,* and *bedano* are sweet-pulped varieties, while the rest have an acid sour taste. But all the twelve varieties, whatever their taste, command a ready sale in the market. *Bedano* (the seedless) is a rare variety; it is not altogether free of seeds as the name would indicate.

BALUCHISTAN[1].—Pomegranate is cultivated commercially in Baluchistan. It is also imported from Kandahar in fairly large quantities through Chaman. There are four varieties of commercial importance in this Province, viz.:—

1. *Kandhari.* Grown in Pishin sub-division, mostly in Killa Abdulla and Gulistan. It is slightly acid in taste, very juicy and large in size. Its skin is of brick red colour.
2. *Metha.* Grown in Loralai district. 75 per cent. of the total area in this district is under this variety. It is thick skinned, juicy, less acid in taste, and medium in size.
3. *Khata.* Grown in Loralai district. It is sour in taste, small in size, thick skinned, and less juicy.
4. *Jhalari.* Grown in Loralai district. Big size, soft skin, a little acid in taste, and juicy.

The so-called *Bedana,* or seedless variety has no commercial importance. It is grown in Loralai district, but only a few plants are seen here and there in the orchards, which are kept for home consumption. It is a shy-bearer, which seems to be the chief reason for its limited cultivation. It is sweet and juicy, and a very small residue is left after the juice is extracted.

PUNJAB.—The following information was supplied by the Fruit Specialist, Punjab, Lyallpur: 'Pomegranate is not a very important crop in the Punjab. It is grown in a tract known as Alipur in Muzaffargarh district of the Punjab. No separate figures of area are available, but the area in that tract as well as small patches of pomegranates found here and there in the Punjab would not exceed more than a few thousand acres. In Muzaffargarh district an average yield of 1 maund of fruit is obtained per tree which sells in the market at retail sale of annas 2 to annas 4 per seer depending upon the quality.'

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[1] From the Agricultural Officer in Baluchistan; 1940.

JODHPUR.—The area under Pomegranate cultivation, and also the estimate of the yield of Pomegranates per bigha in Jodhpur is shown in a statement sent by the Superintendent, Hawala Department[1] :—

Village	Area under Pomegranate	Estimate of yield per bigha
Bagan	3 bighas 10 biswas ...	10 maunds
Gavan	30 ,, — ...	90 ,,
Suthla	7 ,, — ...	21 ,,
Umaidsagar ...	2 ,, — ...	6 ,,
Mandore	12 ,, — ..	36 ,,
	54 bighas 10 biswas ...	163 maunds

PESTS AND DISEASES.

The different varieties of pomegranate have been found to suffer from attacks of birds and insects, and from fungus infections.

Birds.—Parrots are the only birds attacking pomegranates. They visit the plantation especially in the morning and in the evening and should be regularly watched.

Insects.—In addition to white ants which do much damage to cuttings in the nursery bed, various other insects are known to injure the pomegranate tree; they are fruit-borers, stem-borers, and sucking insects.

'An insect, says Firminger, which I have detected to be a certain hairy caterpillar, penetrates the hard rind when the fruit is a little more than a quarter grown, and by devouring part of the interior, causes the remaining part to canker and rot. To obviate this, the fruit, when as yet small, should have the large fleshy calyx by which it is surmounted cut cleanly off, and then be tied up loosely in a piece of linen cloth.' Woodrow recommends 'to gather every fruit that is infested even to a slight degree and burn them. If the cultivators of a district will unite to do this for several years, the stock of that particular insect will greatly be reduced and fair crops during some years may repay the trouble.'

Woodrow quotes the following account of the pest from the *Catalogue of Indian Lepidoptera in the British Museum.*—'The larvae of this butterfly reside in the interior of the pomegranate, seven or eight at least having been reared in the interior of a small specimen of this fruit. Of the mode in which the eggs are deposited by the female in the interior of the pomegranate no information has been received; it is, however, probable that this is effected whilst the fruit is in its very young state. The caterpillars feed upon the seeds and the inner part of the fruit, which is thus weakened, and

[1] 10th February 1940.

rendered unable to support its own weight, and consequently liable to have its stem broken, and to fall to the ground with the first wind. This, however, would be destruction to the inclosed insects; since, in all probability, they would find it impossible to make their escape were the fruit to be suffered to lie rotting on the ground. To obviate this evil, the caterpillars, when full fed, have the instinct to bore a hole about a quarter of an inch in diameter through the hard shell of the fruit whilst it remains on the tree; through this hole they then creep to the stem of the fruit, and spin a white web, which they attach to the basal part of the fruit as well as to the stem for about the distance of an inch along the latter. This web is sufficiently strong to support the pomegranate from falling after the wind has broken the stem near to the fruit.'

The fruit-boring insect is *Virachola isocrates* Fabr. (known as *sursa* in the Deccan), the most important economically of the butterflies, perhaps the only one that is constantly and regularly injurious, and sometimes a serious pest of pomegranate. 'As is well known, writes Aitken in this *Journal* (Vol. I; 1886), the larva feeds inside the fruit of the pomegranate and, some time before becoming a pupa, eats its way through the tough rind and fastens the fruit with silk to its stalk, thus preventing it falling off in case it should wither before the butterfly escapes, as it generally does. I have taken a pomegranate infested with these larvae (several usually inhabit each fruit) and made it stand in an egg-cup, in the morning it was so securely fastened, that in taking up the fruit I lifted the cup.'

The treatments mentioned by Firminger and Woodrow are effective but expensive when applied to large gardens. Bainbrigge-Fletcher has suggested catching of butterflies by hand-nets; but they are difficult to catch, being exceedingly swift, wary, and given to sitting on high trees. Burns thinks that a spray of contact poison when the fruits have just set is more likely to be effective; for it is highly probable that the eggs are laid in the calyx of the flower of the young fruit. 'At the time the pomegranate is in flower,' says Downes, 'and at a very early period, the Hair Streak may be seen very busily occupied about the flowers, and I have little doubt that the eggs are deposited at the bottom of the calyx, from the position in which I have seen the abdomen of the butterfly placed; as the fruit enlarges the eggs are enclosed, and in this situation matured'.

At the Botanical Garden of Ganeshkhind, Kirkee, attempts were made to prevent insect attack by bagging the fruits immediately after fertilisation. Paper bags proved most unsatisfactory as they tore badly. Even paper bags soaked in paraffin wax were not found to be of much use as water entered the bags along the fruit stalk and caused rotting of the fruits. Cloth bags were effective and the cost came to 4 pies each. If carefully used, each bag served for two years. Comparison was made with crude oil emulsion versus tobacco water. This resulted in favour of the crude oil emulsion.

At Sangamner the *bagwan* puts about a pound of asafoetida in the main water channel or in a small water reservoir which is

generally built near wells and through which the water passes. This is done twice or thrice from the second or third watering. Thereby the attack is said to be much lessened.

Mr. M. A. Wynter-Blyth mentions the larva of *Dendoryx epijarbas ancus* Fruhs. as feeding inside the fruit of the pomegranate on the lower slopes of the Simla Hills.[1]

2. A hairy caterpillar (*Euproctis fraterna* Moore) sometimes appears on the pomegranate plant and does some damage to the foliage, but is not as serious a pest as the fruit borer.

3. Another serious pest is the stem borer *Arbela tetraonis* Moore, which bores into the stem and causes the branches to wither. The larva may be known by the peculiar patches of excrement and silk found on the bark of the trees near the bore of the caterpillar, which comes out at night, feeds on the bark, and makes the peculiar covering on the part it eats. The caterpillars may be destroyed by probing them with a piece of thin wire, or by syringing into the burrows either rock oil or a mixture of 2 parts chloroform and 1 part creosote. A good preventive remedy is not to grow shevari (*Sesbania aegyptiaca* Pers.) anywhere in the vicinity, for this is the plant from which the pest generally comes on to the pomegranates.

4. Occasionally small sucking insects, such as aphides, thrips, and mealy wings may become a nuisance in the pomegranate plantation. Mealy wings are of very little moment. Aphides and thrips are easily kept under control by spraying twice or thrice with crude oil emulsion (1 part of crude-oil stock emulsion to 66 parts of water), or better still with incosopal emulsion (1 part of incosopal to 80 parts of water).

Fungi.—Fruit rot is so very common in the pomegranate gardens of the Deccan that the gardeners, far from looking upon it as a calamity, welcome it as a sign of the high yielding capacity of their trees. It is more particularly severe in low situations, in crowded gardens, and in gardens that are neglected and unclean. The loss due to it amounts to about 15-20 per cent. Every garden seems to be attacked and, during the monsoon, every plant in the orchard.

This disease is recognised[2] by the appearance of brown or orange black round pustules on the surface of the fruits, usually near the stalk-end. These pustules appear in regular patches, which may in some cases, extend to even half or more of the fruit surface. This discolouration of the surface extends slowly to the inner tissues and even the seeds, which, consequently, remain immature, small, and pale in colour. Rotting now sets in, especially in the case of young fruits, and the whole fruit becomes dried up and hollow. The fruit loses in weight, and shallow depressions occur on the discoloured portion.

Flowers may also be affected and drop down in large numbers. The fungus may be seen even on the dried up twigs where it remains in the shape of small round pustules ready to infect the succeeding

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[1] *Journ. Bomb. Nat. Hist. Soc.;* vol. xli, p. 737.

[2] M. N. Kamat—Fruit Rot of Pomegranates. *The Poona Agricultural College Magazine*; xv, 3; December 1923.

crop of flowers and fruits. It is a weak parasite, and it has been found to be a species of *Phomopsis*. It is capable of living as a saprophyte on the dead branches and twigs of the trees. And this accounts for its yearly reappearance; for the amount of fruits, flowers, leaves, branches, and twigs that are allowed to decay on the ground all around the trees is enormous.

It is difficult and perhaps uneconomic to devise any direct method of controlling or treating this disease. The nature of the garden and the growth of the plants will not permit of any such operation. The only effective way of checking the infection is to regularly pick out all diseased fruits and flowers and burn them. No dead part of the tree, whether it be fruit, flower or twig should be allowed to remain in the garden, whether on or near the tree; and all those parts ought to be buried. Nor should any diseased part be allowed to rot in the manure pit, as is generally done by the cultivators.

Specimens of pomegranates were received from a garden in Bombay[1], in which the fruit, though of excellent external appearance, were blackened and rotting inside. The fruit appears perfectly healthy on the outside, but when cut open, the seeds and pulp are found blackened either wholly or in part. In the more advanced stages there are cavities inside, filled with a brown powdery substance, composed of the spores of the fungus. The rot was found to be due to a fungus known as *Sterigmatocystis castanea* Patterson, first observed in the United States in 1910.

Domestic Uses.

In his account of the Voyages of the Ambassadors of the Great Duke of Muscovy and the King of Persia (1633-39), Olearius writes: 'The wild pomegranates, which you find almost everywhere, especially at Karabag, are sharp or sowrith. They take out of them the seed, which they call *Nardan*, wherewith they drive a great trade, and the Persians make use of it in their sauces, whereto it gives a colour, and a picquant tast, having been steep'd in water, and strain'd through a cloath. Sometimes they boyl the juyce of these Pomegranates, and keep it to give a colour to the rice, which they serve up at their entertainments, and it gives it withall a tast which is not unpleasant.'

In the East the pomegranate is universally eaten and much esteemed as dessert. The fruit is cut open, seeded, strewn with sugar, and sometimes, as it is particularly the case in Syria, sprinkled with rose water. The Portuguese prefer wine to rose water. The seeds are also much used in syrups and conserves.

The fruit is greatly valued in warm countries on account of the delicious, cooling, and refreshing pulpy seeds which, with the addition of water and sugar, make a very pleasant cooling drink known as *granadine* or *pomegranate-water*. This is much used, not only in the East but also in certain parts of Europe and in the southern states of North America. In India pomegranate *sherbet* is highly esteemed, and justly appreciated by all who have tasted it.

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[1] *The Agricultural Journal of India;* vol. ix, 1914; p. 205.

It is but one step, one very short step, from the sweet juice to the 'Pleasant liquor that distils from the pomgranet fine' (Drayton), and man was not slow in taking that step.

Pomegranate-wine was known throughout the Near East at an early date. In the Canticle of Canticles the bride, when urging the groom to come to her mother's house, says : 'and I will give thee a cup of spiced wine and new wine of my pomegranates'. And in Papyrus Anastasi IV the fellah is advised to refrain from the alcohol of the pomegranate. Ye-lu Ch'u-ts'ai, in the account of his journey to Persia (1219-1224), speaking of the pomegranates of Khojand, which are as large as two fists and of a sour-sweet taste, says that the juice of three or five fruits is pressed out into a vessel and makes an excellent beverage.

A jet-black smooth writing ink is made of the bark of the root. This is much used by Algerian scribes, and in particular by the 'sopherim' when copying the text of the sacred Mosaic books. The barks of both the root and the fruit enter into the composition of popular preparations used by Annamites to lacquer their teeth, or by Moroccans to dye their hair.

The bark is of real value as a tan and dye for leather; it is largely employed in preparing the morocco leather of Tangiers.

The flowers stain the saliva; they are used in various parts of India to impart a light-red colour, said to be fleeting, to cloth. The inhabitants of the Chinese province of Hainan make use of them for fermenting their wine.

The astringent rind of the fruit is a valuable tan, and is also employed as an auxiliary to colouring agents, generally turmeric or indigo, in dyeing. Alone, it imparts to cloth the greenish colour known in the North-West Provinces of India as *kakrezi.* When used for this purpose the rind is boiled in water till three-fourths of the latter has evaporated; and the cloth then dipped in the concentrated infusion. Samples of the rind have been found to contain a small amount of yellow colouring matter, readily given up to boiling water, which imparted colours varying from a dull-yellowish green to a bright reddish-drab with tussur and corah silk, and cotton; and which with salts of iron produced an almost black dye on wool.

In North Africa selected branches or young plants are used for making walking-sticks.

The wood is light-yellow, with a small dark-coloured, irregularly-shaped heartwood, compact and close-grained; it is used for roofs in some parts of India.

The plant makes a good fence, and for this purpose is established by sowing seeds in position, putting in stout cuttings, or transplanting from the nursery.

Medicinal Uses.

According to the *Castel of Helth* 'pomegranates be of good iuyce and profytable to the stomacke, specially they which are sweete.' Their nourishing and digestant properties have been proverbially nutshelled by the Arabs: 'If hungry, eat pomegranate;

if sated, eat pomegranate'. And they had to be eaten at the conclusion of royal banquets in order to facilitate the digestion of fatty viands.

Tobaiah Rofé distinguishes between the properties of the two varieties, sweet and acid. The sweet pomegranate rejoices the heart; and its bark, boiled with water or with wine, promotes the cicatrization of wounds. The acid fruit stops sanguinolent diarrhoeas, allays thirst, and reduces the congestion of the liver and the stomach.

The ancients valued the pomegranate fruit as a stomachic. Whether in the form of a sherbet or of a syrup, it has been used with advantage in typhus, gastric and asthenic fevers, inflammations of the urinary tract, haemorrhages, and colliquative sweats. Hippocrates prescribed it for heartburn, and van Swieten for dysentery and diarrhoea.

Hindu physicians prescribe the juice of the ripe fruit combined with saffron as a cooling drink in dyspepsia and in fevers. The seeds are considered to be stomachic, the pulp cardiac and stomachic; by some it is said to be diuretic and antibilious.

Locally the acid juice is used as drops for the eyes in ophthalmia.

In the Konkan the juice of the green fruit, rubbed with galls, cloves and ginger, is given in honey as a remedy for piles.

In Cambodia the unripe fruit is used in the treatment of diarrhoea and dysentery. For diarrhoeas a small ball of kino is introduced into the fruit, green and about the size of a walnut, and the whole heated over a slow fire until it becomes burning hot; it is then cut and infused in 200-300 grammes of boiling water; the infusion is to be administered in two doses in one day. For dysentery a small pill of opium is used instead of kino, and the burning hot fragments are boiled in a tumblerful of water until two-thirds of it has evaporated; the decoction is to be administered in one single dose.

According to the rabbi Maimonides the pomegranate taken internally with wine is an excellent remedy for the stings of wasps and hornets.

The rind of the fruit, and the flowers were recognized as medicinal by the ancients. They are both powerfully artringent, and were employed in diarrhoea and similar diseases. They were also given for relaxation of the gums and throat, mucous discharges, prolapsus of the rectum or uterus. They are still used as an injection in leucorrhoea, as a gargle in sore throat in its early stages, and in powder form in intermittent fevers. 'A decoction of them, says Culpeper, stops bleedings and purgings of all kinds, and is good for the whites . . . A strong infusion cures ulcers in the mouth and throat, and fastens teeth.'

In India the rind and the flowers in decoction with opium and an aromatic, such as cloves, cinnamon, coriander, or pepper, are used as an astringent in bowel affections unaccompanied with ineffectual and painful straining at stool.

In Madeira an infusion of the flower buds and the rind of the fruit is given for inflammation of the throat, and also for dysentery.

In Guiana the decoction combined with lime juice is used as a gargle. When taken internally the decoction is sweetened with

honey and administered with the juice of the sorrel and of the water cress.

The rinds of three wild pomegranates are said to be used in Java: the red-flowered *merah,* the white-flowered *poetih,* and the black-flowered *hitam.*

The rind of the pomegranate is official in Holland under the name of *cortex fructus granati.*

The juice of the flowers mixed with the root juice of Bermuda grass (*Cynodon Dactylon* Pers.) is used to stop bleeding from the nose. The flower-buds powdered, in doses of 4 to 5 grains, are useful in bronchitis; they are also much used in dysentery and diarrhoea.

The Hausas use a tea-like infusion of the young flowers as a vermifuge. The Arabs rank the flowers of the male plant among their styptics, and the blossoms amongst their cicatrizants.

In Shikarpur, Sind, unripe flowers are dried and pounded, to make a snuff, which is considered to be the best astringent in nasal haemorrhage while internally it is very effective during infantile diarrhoea and dysentery. Green leaves are made into a paste and applied on the eyes during conjunctivitis.

In some parts of India the expressed juice of the leaves and the young fruit is used in dysentery. In other parts the juice expressed from the leaves and flowers is sniffed to stop bleeding from the nose.

In Ceylon the leaves are boiled and used as an eye-wash. In the Philippine Islands the decoction is used as a gargle in all affections of the buccal cavity. In Jamaica the leaves are beaten with oil of roses, and applied to an aching head.

The efficacy of the bark of the root of the pomegranate tree, as a remedy for the tape-worm, has long been established in India.[1] It is given in decoction prepared with two ounces of the fresh bark, boiled in a pint and a half of water, till but three quarters of a pint remain; of this, when cold, a wineglassful may be drunk every half-hour till the whole is taken. This quantity occasionally sickens the stomach a little, but seldom fails to destroy the worm, which is soon after passed.

Pomegranate root is known to have been long used by the Chinese for the expulsion of the tape-worm. And a decoction of it was recommended for a similar purpose by Celsus, Dioscorides, and Pliny. That the Egyptians knew the taeniacide properties of the root bark is evident from their mention in the Ebers and Berlin Papyri: the bark was bruised with beer, mixed with water, and allowed to stand overnight—a mode of preparation which is still followed in Egypt.

While the efficacy of the root-bark as a taeniacide is admitted by every one, opinions differ as to the relative values of the root-bark and the stem-bark, the fresh bark and the dried bark, the bark of the wild pomegranate and the bark of the cultivated plant.

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[1] Udoy Chand Dutt, who made a thorough study of the *Materia Medica of the Hindus* compiled from Sanskrit medical books, remarks that he has not been able to find any notice of pomegranate root-bark in Sanskrit works.

According to Sheikh Abd Erzeraq the flowers, the fruits, and the bark of the pomegranate have anthelmintic properties. The decoction of the root-bark is a common remedy for roundworm in Bengal; while in Bombay the flowers and the pericarp are prepared as ascaricides. In Europe the flowers, either in decoction or in the powder form, are used for roundworms and worms of the genus *Strongylus*. Caius and Mhaskar have shown experimentally that the bark is ineffective against hookworms.

In Cambodia a handful of toasted roots is given in infusion for colic accompanied with diarrhoea.

The Arabs credit the seeds with stomachic properties. In India the seeds are considered cooling and useful in fevers; ground to a paste with milk they are a Tamil cure for renal lithiasis during pregnancy.

The bark and fruit combined with other drugs are prescribed in India for the treatment of snake-bite (Sushruta, Vagbhata, Rasaratnakara); the bark is also prescribed for scorpion sting (Sushruta). Caius and Mhaskar have demonstrated that neither bark nor fruit are an antidote to either snake or scorpion venom.

Pharmacognosy.

Pomegranate bark has a place in many pharmacopoeias. The bark of the root is official in Italy, Mexico, Portugal, and Yugoslavia; the bark of the root and stem in Belgium, Brazil, Denmark, France, Germany, Russia, Spain, and Turkey; the bark of the root, stem, and branches in Austria, Hungary, Japan, and Switzerland; the bark of the root and stem, and the rind of the fruit in Holland.

The rind is in irregular, more or less concave fragments, some of which have the toothed, tubular calyx still enclosing the stamens and style. It breaks easily with a short corky fracture. Externally it is rather rough of a yellowish brown or reddish brown colour; internally it is more or less brown or yellow, and honeycombed with depressions left by the seeds. It has hardly any odour, but has a strong astringent taste.

The middle layer of the rind consists of large thin-walled and elongated, sometimes even branched, cells, among which occur thick-walled cells and fibro-vascular bundles. Both the outer and the inner surface are made up of smaller, nearly cubic and densely-packed cells. Small starch granules occur sprraringly throughout the tissue, as well as crystals of calcium oxalate.

The root bark occurs in transversely-curved pieces; externally brownish-yellow with conchoidal depressions and dark brown irregular patches in the cork; internally dark yellow, the medullary rays extending to the outer surface. The odour is light, the taste astringent, somewhat bitter and nauseous.

The stem bark occurs in pieces of variable length and thickness. The outer surface is yellowish or greyish-brown, with patches of greyish lichens, broadly elliptical lenticels and yellow-brown furrows or abraded patches of cork; longitudinally wrinkled. The inner surface is light yellow or yellowish-brown, finely striate. It breaks short, with dark green phelloderm and yellowish-green inner bark.

The stem bark differs from the root bark by the presence of a broader cortex whose outer cells contain chloroplastids, and by possessing shorter medullary rays. A transverse section of the bark exhibits the following structure: cork thin, of alternating rows of thin-walled suberized cells and lignified cells with greatly thickened inner walls; cortex of parenchyma with a few large stem cells isolated or in small groups; medullary rays mostly one-cell wide; rosette aggregates of calcium oxalate very numerous in the parenchyma.

The powder is from yellowish-brown to dark brown. It contains calcium oxalate crystals in rosette aggregates or monoclinic prisms; numerous starch grains, spherical, ellipsoidal, biconvex or irregular, and single or compound; fragments of whitish cork with prominent, thickened, lignified walls; stone cells with very thick and strongly lamellated walls; occasional long wood fibers associated with tracheae possessing simple and bordered pores.

In the Dutch East Indies the local product, which mostly consists of small pieces and scrapings, is used instead of the European article. But, as the alkaloidal contents of the Indian bark, more especially that of the white-flowered variety, are relatively much higher than those of the European bark, the Dutch Pharmacopoeia rules that when Indian pomegranate bark is to be prescribed in Holland it shall be as *Cortex Granati indicus*.

Adulteration.

The commercial drug frequently consists partly or entirely of the bark of the stems or branches, characterized by its (less abundant cork-formation, with longitudinal bands or ridges of light brownish cork, but not conchoidal exfoliations. Such bark is considered adulterated in countries which recognize only the root bark as official.

The pomegranate bark is sometimes substituted by the bark of other plants. Among these are *Berberis vulgaris* Linn., which is bitter and not astringent; *Buxus sempervirens* Linn., which is also bitter and free from tannin; and *Strychnos Nux-vomica* Linn., or false Angostura bark which has a dark inner surface and a very bitter taste. None of these barks have the characteristic checkered appearance of the transverse surface of genuine pomegranate bark.

Chemistry.

The inner surface of the bark, steeped in water and then rubbed on paper, produces a yellow stain, which by the contact of ferrous sulphate is rendered blue, and by that of nitric acid acquires a slight rose tint, which soon vanishes. These properties serve to distinguish this bark from those of the box root and barberry.

The root bark yields over 22 per cent. of tannin, and a considerable amount of mannitol. It contains five alkaloids, which bear a close relationship to the hemlock alkaloids. The active constituent is believed to be 'pelletierine', which is highly toxic to tapeworms, and explains the use of the bark, and the mixed alkaloids in the form of the so-called, 'pelletierine tannate' and 'pelletierine

sulphate' as anthelmintics. The 'tannate' is official in the Pharmacopoeias of Brazil, Great Britain, Italy, Mexico, and United States of America, and the 'sulphate' in the French Codex.

The bark of the stem usually contains slightly less alkaloid than the bark of the root. The amount in the stem bark has been determined by various investigators to range from 0.35 to 0.6 per cent., and in the root from 0.6 to 1.0 per cent. Stoeder, in 1890, found out that of the root bark of three varieties of the wild pomegranate recognized and used by the natives of Java, the red-flowered *merah* yielded 2.43 per cent., the white-flowered *poetih* yielded 3.75 per cent., and the black-flowered *hitam* yielded 1.71 per cent.

Popular Beliefs.

In various parts of India the flower and the fruit of the pomegranate are given to women to eat, so that they may conceive sons.

Among the Arabs, the bride, when dismounting before the tent of the bridegroom, receives a pomegranate, which she smashes on the threshold, and then flings the seeds into the interior of the tent. The Arabs would have a man like the pomegranate: 'bitter-sweet, mild and affectionate with his friends in security, but tempered with a just anger if the time calls him to be a defender in his own or in his neighbour's cause.'

In China the pomegranate is regarded as a symbol of fertility. We read in the 'Pei si' that two pomegranates were presented to king Nan-te of Ts'i on the occasion of his marriage to the daughter of Li Tsu-sou, who explained that the fruit encloses many seeds, and implies the wish for many sons and grandsons. Thus the pomegranate is still a favourite marriage gift and plays a part in the marriage festival. The same obtains in modern Greece.

In ancient Greece the pomegranate was one of the plant remedies for sterility. In cases of difficult labour the Romans gave the parturient woman pomegranates and a decoction of fenugreek.

Mythology.

The pomegranate was one of the attributes of Aphrodite or Venus, the goddess of love and beauty; of Demeter or Ceres, the goddess of agriculture and vegetation; and of Dionysus or Bacchus, the youthful, beautiful, but effeminate god of wine.

The attribute of Persephone or Proserpina as the wife of Hades or Pluto was the pomegranate, and her votaries had to abstain from this fruit. When carried off to the under-world Persephone resisted, begged, and implored gods and men to help her, but Zeus approving the transaction let it pass. Although she had been thus carried off by force she loved her husband, and when her mother, Demeter, implored her to come back to earth, her answer was that she had accepted from him the half of a pomegranate, or apple of love, and had eaten it. Persephone, who has eaten of the pomegranate, is the fructified flower that returns in spring, dwells in the region of light during a portion of the year, and nourishes men and animals with the fruits.

Religion.

The pomegranate is one of the fruits offered to the deity by a Hindu woman taking the 'Saubhagya Vrat', that cruel death may not snatch away from her the husband she loves.

It is also one of the nine plants that make up the 'Navapatrika' worshipped on the occasion of the Durgapuja, as carried in some districts of Bengal.

There is abundant proof that the ancient Egyptians offered pomegranates to the gods and to the dead, and that the tree was sacred both to the Semites and to the Greeks.

The pomegranate figures in the New Year ceremonies of the Jews, and the blessing is as follows: 'May your approbation be granted, O Lord, our and our forefathers' God, to be full with good deeds as a pomegranate[1].'

According to the Koran there are fruits in paradise: the date and the pomegranate.

There is current among the Arabs a 'hadi' or traditional saying that: 'whosoever eats pomegranates when he is hungry, his heart will be illumined for forty days and he will be immune from the temptations of the devil—and, therefore, will not sin, and, therefore, will enter heaven.'

Another saying is that: 'whenever the Imam Ali wanted to eat pomegranates he would spread a cloth. He was asked the reason for it; and he answered that every pomegranate contains a grain of the heavenly pomegranate and that whenever infidels want to eat that grain, by God's command angels take it to prevent them from eating it.'[2]

Art.

The pomegranate tree and its fruit occupy a prominent place in Egyptian and Assyrian decorations and works of art: ivory, metal, pottery. They may also be seen on preserved specimens of pottery from Jerusalem and on some Jewish coins.

Among other details relating to the making of the ephod of the High Priest, the Exodus prescribes the following: 'And beneath at the feet of the same tunick round about, thou shalt make as it were pomegranates, of violet, and purple, and scarlet twice dyed, with little bells set between: so that there shall be a golden bell and a pomegranate, and again another golden bell and a pomegranate.'

In 1408, Quercia executed in Ferrara various sculptures, notably the 'Madonna of the Pomegranate.'

Heraldry.

The pomegranate appears in the escutcheons of the South American Republic of Colombia, and of Bogota, its capital. It is also found in the arms of the Spanish city of Granada, and in the seal of its University; in those of the towns of Granadella and

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[1] Dr. David Judah, M.D.
[2] Prof. K. Dehdashti, B.A. (Hons.)

Santafé, in the Spanish province of Granada; and of Tregoney, in Cornwall.

The arms of the Sassoon family are: 'or, a palm tree eradicated proper between *on the dexter a pomegranate, also proper,* and on the sinister a branch of laurel fructed, vert, both proper, on a chief azure a lion passant of the first, in the dexter paw a rod erect, gold.'

Literature.

One of the most familiar of the Rabbinical interpretations designed to expound the symbolism of the priestly decoration prescribed in Exodus is that it indicates 'something like an alternation or mixture of music with discoursing, sound with sense, poetry with thought.' And this is what Robert Browning meant to convey to the minds of his readers when he chose as a title for his poems *Bells and Pomegranates*[1].

Mrs. Browning refers to her husband's successive pamphlets in her poem *Lady Geraldine's Courtship*:—

> Or from Browning some 'Pomegranate', which
> If cut deep down in the middle,
> Shows a heart within blood-tinctured, of a veined humanity.

Sanskrit poets often compared the redness of the cheeks or lips to the colour of the red seeds of the pomegranate. A simile not altogether unknown in the West:—

Her cheeks like . . . faire pomegranade kernels washt in milke (*Greene*).

Her temples, peices of Pomegranates seeme (*Robinson*).

That small pomegranate-like mouth (*Ouida*).

As a pomegranate, cut in twain,
White-seeded is her crimson mouth (*Oscar Wilde*).

The young pomegranate's blossoms strew
Their blooms in blushes ever new (*Byron*).

As rosy as a half-opened pomegranate (*Flaubert*).

In the *Journal* of the Malayan Branch of the Royal Asiatic Society (vol. xvii, part III, January 1940) Mr. R. O. Winstedt gives the following as an example of a Malay quatrain (*pantun*).

> *Satu tangan bilangan lima,*
> *Dua tangan bilangan sa-puloh.*
> *Sahaya bĕrtanam biji dĕlima,*
> *Apa sĕbab pĕria tumboh?*
>
> I find one hand has fingers five,
> I count up ten upon the two:
> What is the matter, man alive,
> Pomegranate planted and gourd grew!

Apparently the conundrum is about a gardener who counts his plants and finds their tale complete, but is astonished to discover a gourd growing where he had planted a pomegranate. However, to the Malay mind the *pantun* conveys much more than meets the ear; for in the Malay language of fruits a pomegranate stands as

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[1] Prof. C. D. Pinto, M.A., L.L.B.

a simile for the purple lips of the Eastern beauty and the bitter gourd as a symbol of disappointment.

And here is a delightful little Marathi tale:—'In the house of learned men, who were profusely rewarded by king Bhoja, women, while playing in the yard got their pearl-necklaces broken and the pearls were scattered on the ground. These pearls were tinged by the lac-dye that was stamped on the floor, while the women were playing on the ground. The pearls thus coloured *red* by the lac-dye of the soles of the women's feet attracted parrots who mistook them for pomegranate grains and began to pick them up.'[1]

Proverbs.

'*Omni malo punico inest granum putre*', says the Latin : Every pomegranate has its rotten pip.

Ek anār, sau bīmār': one pomegranate to a hundred sick. A Hindustani proverb used when there are many candidates for the same post: 'one post to a hundred applicants.'

'*Kauvē kī dum mēn anār kī kāli*': pomegranate blossoms on a crow's tail. A Hindustani proverb used to describe a black ugly person finely dressed.

Indian Market.

Bombay:—Regarding the Bombay Market the following information was supplied by Mr. D. S. Laud, Superintendent of Markets and Slaughter-Houses, Bombay :—

'Pomegranates sold in our local markets are obtained from Bhawnagar, Dholka, Kabul, Maskat, Poona, and Harnai. Most of the good quality of fruits comes from Kabul.

'The chief local fruit on sale is that from Poona, of which about 500 baskets are sold daily during the months of August, September and October.

'The approximate quantities of pomegranates imported into Bombay from Kabul and other areas and the seasons are shown below:—

from Bhawnagar and Dholka, 100 to 150 baskets per day during the months of March, April and May;

from Poona about 500 baskets per day during the months of August, September and October;

from Maskat, 200 to 250 baskets per week during the months of October, November, December and January;

from Kabul, 75 to 100 *kulus* (long baskets) on every alternate day during the months of October, November, December and January.'

Synonymy.

Granatum punicum St. Lag. in Ann. Soc. Bot. Lyon, vii (1880) 132.

Punica florida Salisb. Prod. 354.

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[1] Prof. N. K. Bhagwat, M.A.

Punica Granatum Linn. Sp. Pl. 472.
Punica grandiflora Hort. ex Steud. Nom. ed. I. 669.
Punica nana Linn. Sp. Pl. ed. II. 676.
Punica spinosa Lam. Fl. Fr. iii. 485.
Rhoea Punica St. Lag. in Ann. Soc. Bot. Lyon, vii (1880) 133.

Vernacular Names.

Afrikaans: Iralnate—; *Amharic*: Ruman—; *Annam*: Cay luu, Thach luu—; *Arabic*: Rana, Rana rumman, Rumman, Shajratur-rumman—; *Aramaic*: Rummāna—; *Assam*: Dalim—; *Baluchi*: Anar, Nargosah—; *Bengal*: Dalim, Dalimgachh, Darim—; *Berber*: Armoun—; *Bombay*: Anara, Dalimba, Darima—; *Brazil*: Roma—; *Burma*: Salebin, Talibin, Thale—; *Calcutta*: Baidana—; *Cambodia*: Totim—; *Canarese*: Dadima, Dadimbe, Dalimbare, Dalimbe, Dalimbu, Hulidalimbe, Husidalimbe—; *Catalan*: Magraner—; *Cham*: Dalim—; *Chinese*: An Shih Liu, Che Lieou, Liou Pi, Ngan Shih Liu, Shih Liu—; *Cochin-China*: Cay-thach-luu—; *Coptic*: Erman, Herman—; *Danish*: Granattraee—; *Deccani*: Anar, Dhalim, Dharimb—; *Dutch*: Granatboom—; *Egypt*: Anhmani, Arhmani, Rumman—; *English*: Pomegranate Tree—; *Ewe*: Aboda—; *French*: Balaustier, Grenadier, Migraine, Miouganier—; *German*: Granaat baum, Granate—; *Greek*: Roa, Rodia, Roia, Roidia, Roidion—; *Gujerat*: Dadam, Dadum—; *Hausa*: Rumman, Rummani—; *Hebrew*: Rimaus, Rimmon, Rimnon—; *Hindi*: Anar, Dalim, Darim, Daru, Darum, Dhalim, Dharimb, Gulnar—; *Hova*: Aponga-beandanitra—; *Indo-China*: An thach luu, Luu, Luu chua trap, Phila, Thap luu—; *Iraq*: Rumman—; *Italian*: Melogranato, Melograno—; *Japanese*: Sakaro, Sakuro, Zakuro—; *Jaunsar*: Danoi—; *Javanese*: Gangsalan—; *Jhalawan*: Anar, Sor—; *Jolo*: Dalima—; *Kharan*: Hanor—; *Khmer*: Tatim—; *Konkani*: Dalimb, Dallimbini—; *Kotra*: Anar—; *Kumaon*: Darim—; *Kurdish*: Hannar—; *Languedoc*: Gronodié, Miouganié, Miougranié—; *Malaya*: Delima, Shak liu—; *Malayalam*: Dadimam, Matalam, Pumatalam, Raktabijam, Talimatalam, Uruyampalam—; *Malta*: Pomegranate, Melogranato, Rimmien, Rummien—; *Marathi*: Dalimb, Dalimba—; *Mexico*: Granado, Granado de China—; *Michi*: Madala—; *Mundari*: Anardaru—; *Naples*: Granato, Granato servaggio—; *North-Western Provinces*: Anar, Darim—; *Persian*: Anar, Darakhtenar, Dhalim, Dharimb—; *Philippines*: Dalima, Granada—; *Polish*: Drzewo granatowe—; *Portuguese*: Romanzeira, Romeira—; *Potenza*: Gronuto—; *Punjab*: Anar, Daan, Danu, Daran, Dariun, Daru, Daruna, Daruni, Dhalim, Dharimb, Dharu, Jaman—; *Pushtu*: Anar, Anor, Gharnangoi, Nargosh—; *Quetta*: Anarbedama—; Romagna: Melagrano, Melgarne, Melingarne—; *Roumanian*: Pitligean, Pitlingean, Rodiu—; *Russian*: Granat, Granatnik—; *Sanskrit*: Bijapura, Dadima, Dadimasára, Dadimba, Dalika, Dantabija, Dantabijaka, Darimba, Karaka, Kuchaphala, Kuttima, Lohitapushpaka, Madhubija, Milapatra, Milapatraka, Mukhavallabha, Nagarata, Parvaruta, Phalashadava, Pindapushpa, Pindira, Raktabija, Raktapushpa, Shukadana, Shukavallabha, Sunila, Suphala, Svadvamla, Valkaphala, Vrittaphala—; *Shahrig*: Nargosa—; *Sibi*: Anar, Dahrun—; *Sicily*: Granatu—; *Sind*: Anar, Dhalim, Dharimb—; *Sinhalese*: Delun, Delungaha, Delunghedi—; *Sinjawi*: Anangi—; *Spanish*: Granada—; *Swedish*: Granatrad—; *Syriac*: Rumono—; *Tamil*: Kalumal, Madalai, Madulam, Madulungam, Magilan, Pumadalai, Pulimadalai, Tadimadalai, Tadimam, Tusagam—; *Telugu*: Dadimamu, Dadimba, Dalimma, Danimma, Karakamu, Pulladanimma, Puvvudanimma, Tiyyadanimma—; *Timne*: Labo—; *Treviso*: Melogranato, Pomi ingranai—; *Tuareg*: Tarrumant—; *Tulu*: Dalimbe—; *Turkish*: Nar—; *Tuscany*: Granata, Melagranata—; *Urdu*: Anarmitha—; *Uriya*: Dalimbo, Dalimo—; *Verona*: Magragnar—; *Waziri*: Narghesa—; *Yemen*: Ruman—; *Yugoslavia*: Magranj, Nar, Sipak—.

THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART V.

(*Continued from Vol. xli, page 320*).

RHOPALOCERA.

PAPILIONIDAE.

Polydorus hector L.
Moore, *Cat. Lep. Mus. E.I.C.*, i, 93, pl. 2, figs. 4, 4a, 4b. 1857.
Moore, *Lep. Ceyl.*, i, 152. 1880-81.
Moore, *Lep. Ind.*, v, 173, pl. 435, figs. 1, 1a, 1b. 1901-03.
Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 19. 1907.
Bell, *Journ. Bomb. Nat. Hist. Soc.*, xx, 1130-32. 1911.
Talbot, *Fauna Brit. Ind.*, Butterflies (2nd. edit.), i, 84. 1939.

Head black, the clypeus outlined in crimson. Body blackish purple. 1st somite with a short sublateral and a long lateral orange red tubercle, a black dorsal plate with four orange red spots anteriorly and two posteriorly. 2nd somite with a short lateral and sublateral and two longer subdorsal orange red tubercles. 3rd somite similar. 4th and 5th also similar but the outer subdorsal tubercle obsolescent on the 4th and absent on the 5th somite. 6th to 11th somites with a very low set sublateral short tubercle and a longer lateral and subdorsal. 12th and 13th somites with subdorsal tubercles only. 5th somite with a pale orange red spot above and posterior to the lateral tubercle and another anterior to the subdorsal, an orange red transverse dorsal band. 6th to 8th somites each with a pale orange red spot anterior to the subdorsal tubercle, a pair of oval dorsal spots on the anterior margin and with traces of a transverse dorsal band. There is some variation in the amount of marking. Legs and spiracles black. Prolegs blackish purple. Osmeterium orange.

Pupa suspended by a girdle and tail pad of black silk. Head flattened frontally and expanding into a slight lobe on each side. Thorax with a double keel and a slight lateral lobe. Wing cases expanded laterally and developing into a lateral lobe. 4th to 7th abdominal somites each with a pair of subdorsal rounded lobes. Colour pinkish russet, the wing cases slightly darker and mottled. The prothorax with two white subdorsal streaks, the abdomen marked with white above the wing cases. The pupa is very similar to that of *P. aristolochiae* F. (mihi, *Journn. Bomb. Nat. Hist. Soc.*, xl, 392), but the cephalic lobes are slightly smaller and those on the abdomen are smaller and more erect. The colour is more pinkish, that of *aristolochiae* being slightly tinged with olive.

Food-plant—*Aristolochia* spp.

Described from a full fed larva found at Gopalpur (Dist. Ganjam) 8-iii-40, pupated 14-iii-40, and a male emerged 1-iv-40.

SATYRIDAE.

Ypthima hubneri Kirby, *hubneri*.

de Niceville, *J.A.S.B.*, 231, pl. 12, figs. 1, a, b. 1886.

Moore, *Lep. Ind.*, ii, 77, pl. 111, fig. 1. 1893-96.

Bingham, *Fauna Brit. Ind.*, Butterflies, i, 143. 1905.

Ovum spherical, the base slightly flattened. Pale bluish green. Minutely punctate. Laid singly on the blades of grass. Deposited 30-vi-40. Hatched 6-vii-40.

Newly hatched larva pale buff marked laterally with purplish and clothed with short hairs. The body colour changes to green as soon as it has fed but the head remains buff. Resting attitude with the head and fore-part of the body curved downwards. Moulted 10-vii-40.

2nd instar—Head and body pale green. A darker green dorsal line, a slightly waved white subdorsal and lateral line with a third line between them. Ventral surface paler. Anal plate divided into two points. Body clothed with short hairs. Moulted 14-vii-40.

3rd instar—Similar but with a pale subspiracular stripe. Moulted 18-vii-40.

Final instar—Head green. Body green, pubescent. A dark green dorsal stripe, becoming whitish on the 1st and 2nd somites. A slightly waved whitish subdorsal line with two more below it. A pale subspiracular stripe. Legs and prolegs green. Anal plate ending in two short pinkish processes. Length about seven-eighths of an inch. Two larvae in a batch of fifty bred from ova were pale purplish instead of green, with a dark purplish dorsal stripe and with the white lines more distinct. Pupated 24-vii-40.

Pupa suspended by the cremaster. Yellowish green in colour, the thorax and wing cases less tinged with yellow. A brownish black stripe along the dorsal edge of the wing case and a series of black specks along the outer margin. Thorax humped and slightly keeled, in some specimens the keel outlined in brownish black. A very few examples have the wing cases shaded with black. A female emerged 31-vii-40.

Food-plant—Grasses.

The larvae usually hang up for pupation during the night and change late the following evening. The imagines usually emerge between eight and ten in the morning.

Described from material bred from a female caught at Calcutta.

de Niceville, quoted by Bingham, writes :—'About one inch in length, with two divergent processes from the anal segment pointing backwards. Colour entirely green with a dorsal line somewhat darker green, which becomes white at the fourth segment, and extends right through the crown of the head; there is also a paler green lateral line below the spiracles. Pupa green or brown, with the head rounded, the edges of the wing-cases raised and angled anteriorly; the thorax humped and marked like the abdominal segments, with some dark brown waved lines and spots.'

NYMPHALIDAE.

Atella phalanta Drury.

Moore, *Lep. Ceyl.*, i, 62, pl. 31, fig. 1a. 1880-81.

de Niceville, *Butt. Ind.*, ii, 30. 1886.

Davidson & Aitken, *Journ. Bomb. Nat. Hist. Soc.*, v, 269. 1890.

Moore, *Lep. Ind.*, iv, 197, pl. 360, figs. 1, 1a-1f. 1899-1900.

Bingham, *Fauna Brit. Ind.*, Butterflies, i, 412. 1905.

Head black with a small white pear-shaped central spot. Body grey, minutely speckled with white, the dorsum paler with a black dorsal line. A zig-zag sublateral cream coloured stripe. 1st and 2nd somites each with a lateral and subdorsal longish black branched spine, 3rd somite with the subdorsal spine only. 4th to 11th somites with a subdorsal, lateral and sublateral spine, 12th and 13th with subdorsal spines only. Legs black. Prolegs greyish. Spiracles black ringed with white. Venter tinged with yellow. One specimen had the upper half of the head pale reddish brown. Before pupation the dorsum becomes tinged with yellow, the whole body finally turning green with the bases of the spines ringed with white.

Pupa with the head square in front with a pair of very small horns. Thorax slightly humped with a pair of short subdorsal spines on the pro- and meta-thorax. 4th, 6th, 8th and 9th abdominal somites each with a pair of subdorsal spines, 1st and 3rd each with a pair of raised subdorsal spots, 5th and 7th each with a pair of very small subdorsal spines. Suspended by the cremaster from a pad of white silk and hanging at an angle of about thirty degrees from the horizontal. Ground colour mother-of-pearl tinged with pink and with the following black and metallic silver markings. Black—three small spots on the front of the head, a circle round the eye, the cephalic horns, the base of the prothoracic spines, the anterior portion of the metathoracic spines and an irregular blotch in front of them, the thorax along the junction with the wing cases, an irregular triangular costal mark a third of the way from their base, a series of lanceolate spots on the outer margin of the wing cases, the antenna and proboscis cases, the anterior part of the spines and raised spots on the 1st, 3rd, 4th, 6th and 8th abdominal somites and the whole of the spines on the 5th, 7th and 9th, a minute speck next to the spine on the 7th somite, a series of short transverse dashes on the venter, a lateral blotch on the 3rd, 4th and 5th abdominal somites and the cremaster. These black markings vary considerably in size. Metallic silver—the centre of the eye, the back of the prothoracic and metathoracic spines and also of the spines and raised spots on the 1st, 3rd, 4th, 6th and 8th abdominal somites, the inner margin of the wing cases and a streak along the outer edge.

Described from a number of full fed larvae found at Gopalpur (Dist. Ganjam) 16-iii-40, one of which pupated 19-iii-40, and a female emerged 24-iii-40.

Moore gives a very bad figure of both larva and pupa in *The Lepidoptera of Ceylon* and the following description:—'Larva purple-brown; head armed with two delicate branched spines, each

segment with two dorsal rows of similar spines and two lateral rows of shorter spines. Feeds on *Flacourtia, Salix,* etc. Pupa pale green, tubercular along the back.' Bingham quotes Davidson and Aitken as follows.—'Larva cylindrical, moderately thick, very smooth . . . . bears six longitudinal rows of branched spines. The head is unarmed. The colour varies from dark brown to pale yellowish-green, with a white or yellowish spot at the base of each spine. It feeds on one or more species of *Flacourtia.* Pupa colour very variable, some specimens being almost white and some bright green, the markings are usually silver soled, or tipped with red.' He also quotes de Niceville's description of the pupa 'A beautiful green with a subdorsal series of five acutely pointed tubercles, marked with red between each pair of very small blunt ones, the upper edge of the wing-covers and a spot on each side of the head also marked with red.'

LYCAENIDAE.

Rapala schistacea Moore.

Head brown, very small and retractile. Body flattened, pale yellowish green. Somites deeply cut and with a subdorsal and sublateral series of slight humps. Skin pubescent, the subdorsal humps bearing short black bristly hairs, the sublateral humps white ones. Gland fairly large. The larva is well concealed by its appearance when resting among a bunch of the flower buds of its food-plant.

Pupa formed in captivity on the bottom of the box under a leaf, resting on a very thin mat of silk and held in place by a slight girdle and the cremaster. Head and anal end obtuse, the abdomen rather swollen laterally, thorax and abdomen domed dorsally with a slight depression between the two, ventral surface flat, but this may be due to the situation in which the pupa was formed. Colour pinkish speckled with black, the wing cases tinged slightly with olive green, and with a blackish subdorsal stripe edging the thoracic dome and then running along the abdominal somites. Under a lens the body is seen to be covered, with the exception of the wing cases, with short whitish hairs. Wing cases minutely punctate.

Food-plant—*Quisqualis indica* Linn.

Described from a full-fed larva found in Calcutta 19-x-39, pupated 23-x-39, and a female emerged 31-x-39.

HETEROCERA.

LYMANTRIIDAE.

Euproctis subfasciata Wlk.

Head very dark brown, the bases of the antennae white. 1st somite black with two subdorsal white streaks, a smaller lateral white streak and a black subdorsal wart tufted with greyish hair. The rest of the body blackish grey, a double white dorsal line from the 6th to 10th somite and a very faint whitish lateral line. 2nd and 3rd somites each with four brownish warts across the

dorsum and a reddish lateral wart, all tufted with brownish hair. 4th and 5th somites each with a dorsal black hump, a subdorsal black wart and a reddish lateral wart, all tufted with brownish hair. 6th to 11th somites each with four black warts across the dorsum and a reddish lateral wart, all tufted with brownish hair. 12th somite with four small greyish warts tufted with brownish hair. The dorsal glands on the 9th and 10th somites pinkish red. Legs black. Venter and prolegs grey.

Pupa olive brown, the thorax more chestnut, the wing cases greener. Enclosed in a cocoon of thin whitish brown silk mixed with larval hairs.

Food-plant—*Quisqualis indica* Linn.

Described from a full-fed larva found in Calcutta 26-v-40, spun 1-vi-40, and a male emerged 16-vi-40.

Arctiidae.

Creatonotus transiens Wlk.

Moore, *Lep. E.I.C.*, 290, pl. 13, fig. 5. 1857-59.

Hamps., *Fauna Brit. Ind.*, Moths, ii, 29. 1894.

Ovum very pale yellow, spherical, flattened at the base, without sculpturing. Laid in large batches, each individual ovum touching the ones next to it. Hatched on the fourth day.

Young larva greyish with transverse black bands on the 3rd, 4th and 10th somites. Hair grey. Head black. Later with a white dorsal stripe edged with black between the transverse bands, the anal somite orange and a series of orange sublateral warts.

Full-grown larva—Head black, marked with white above the jaws and with a pale inverted V-shaped mark outlining the clypeus. Body greyish black minutely speckled with white on the lateral areas. A broad white dorsal line interrupted on the 3rd, 4th, 10th and 11th somites by wide black transverse bands. A pale cream lateral streak on the 2nd and 3rd somites. 5th to 9th somites with double oblique pale ochreous lateral streaks, and with traces of similar streaks on the 11th and 12th somites. Hairs blackish brown. Spiracles white. Legs black. Prolegs deep purplish pink.

Pupa in a thin cocoon of whitish silk mixed with larval hair. Pale chestnut brown, the intersegmental areas and a dorsal stripe on the abdomen darker. Not quite as dumpy as the usual Arctiine pupa.

Food-plant—Various Composites, and probably many other species of low plants.

Described from a number of larvae bred from ova in Calcutta, one of which pupated 29-viii-39, and a male emerged 5-ix-39.

Hampson's description, which is apparently based on that of Moore, is 'black, blotched with red-brown and with tufts of red-brown hair, the lateral tufts arising from ferruginous tubercles; a dorsal broad white line; head black, marked with white.'

Asota caricae Bsd. (*alciphron* Cr.).

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xl, 402. 1938.

The colouring of the head in this species is variable. Out of

a batch of larvae found in Calcutta in August 1939, the majority had the head red, as recorded by Hampson and Moore. A smaller number had the head black with the vertex marked with red, as previously recorded by me, and there were a very few intermediates.

SPHINGIDAE.

Cephonodes hylas L., *hylas*.

Sevastopulo, *Journ. Bomb. Nat. Hist. Soc.*, xli, 315. 1939.

Head grey. 1st somite swollen, black with minute whitish tubercles. Ground colour very pale grey, the secondary segmental lines darker. A pale lavender subdorsal line edged below with white and with a small black spot immediately below it in the middle of each somite from the 2nd to the 10th. Legs purple. Prolegs purplish. Anal flap and claspers purple with minute whitish tubercles. Horn black and tuberculate. Spiracles white with a transverse orange bar and with an ill-defined grey blotch immediately behind each. Another specimen had the subdorsal line and black spots obsolete and a third a black streak centred with white in place of the spots. In some cases the ground colour was considerably darker than in others.

Described from a full-fed larva found at Gopalpur (Dist. Ganjam) 12-iii-40, pupated 16-iii-40, and a male emerged 30-iii-40.

The dark forms were considerably commoner than usual and outnumbered the green by about two to one. Three larvae found when in the first instar were green but became almost jet black after ecdysis, and finally developed into the form with the broad black dorsal stripe.

NOCTUIDAE.

Prospalta capensis Guen.

Moore, *Lep. Ceyl.*, iii, 29, pl. 147, fig. 2a. 1884-87.

Hamps., *Fauna Brit. Ind.*, Moths, ii, 211. 1894.

Warren Seitz, *Indo-Austr. Noctuidae*, xi, 346.

Head brownish green with a broad black stripe on either side running from the outer edge of the mandibles to the vertex, where it is slightly broader. Ground colour pale brownish green, an interrupted white dorsal line edged with dark crimson and ending on the 11th somite in a white spot. A very fine white subdorsal line, between which and the dorsal line there are three minute crimson-ringed white spots on each somite from the 4th backwards, of these the central one is nearest the dorsal line and the anterior one is the smallest. 2nd and 3rd somites with a transverse series of four similar dots on each side of the dorsal line. A spiracular stripe, white and fairly broad and tinged with crimson, immediately above which there is a white dot broadly ringed with crimson over each spiracle from the 4th to 11th somite. 6th to 8th somites each with a pair of sublateral white crimson-ringed dots. Legs black. Prolegs and the whole area below the spiracular stripe very pale greenish. 11th somite slightly humped dorsally. Spiracles white ringed with black.

Pupa in an earthen cell. Red brown, the thorax and wing cases tinged with olive green, a dark dorsal stripe and the intersegmental areas of the abdomen darker. Cremaster ending in two sharp spines.

Food-plant—Found on Marigold, but fed up on Cosmos, preferring the flowers.

Described from a full-fed larva found in Calcutta 12-i-40, pupated 17-i-40, and a male emerged 1-ii-40.

All the published descriptions that I have seen are based on that of Moore. This is: 'Larva smooth, pale green, anal somite conical; with a dorsal and lateral series of purple-brown blotches dotted with white, and a sublateral row of white dots. Pupa greenish, with reddish segmental bands. Feeds on Acanthads.' Moore's plate shews a pupa with the head, thorax, wing cases and intersegmental abdominal areas bright green, the rest almost scarlet.

(*To be continued*).

A REPTILE AND AMPHIBIAN MISCELLANY.

BY

CHARLES MCCANN, F.L.S.

PART II

(*Continued from Vol. xli, p. 764*).

(*With 6 plates*).

SUBORDER : SAURIA (*contd.*)

FAMILY : *Agamidae.*

Draco dussumieri Dum. & Bibr. Flying Dragonet.

On the 10th June, 1938, Mr. A. R. Hughes and I saw a specimen of this species in the forests of Gersoppa Falls, N. Kanara. The animal parachuted from one tree to another, a distance of some 60 feet. As soon as it alighted, it ran up the trunk for a foot or so, much after the fashion of a Tree-creeper (*Certhia*). Though I stoned it in an attempt to secure it, it made no attempt to parachute again, but just moved round the trunk climbing a little higher each time, just as a Bloodsucker (*Calotes versicolor*) would do under similar circumstances. It eventually dropped after being hit, but was lost in the undergrowth. The upper surface was entirely black, like the bark of the tree, with no indication of markings.

Habits.—Apparently nothing is known of the habits of *Draco dussumieri,* but under the heading of the genus the *Fauna* (vol. ii, p. 137, 2nd Ed.), referring to the gular appendage, states, 'The gular pouch is usually much larger in the males than in the females'. In *dussumieri* the males always possess the larger appendage. Continuing the *Fauna* adds, 'Both it (appendage) and the wattles are distensible, or erectile, and are utilized by the males during courtship.' Though the gular appendage may be used during courtship, this does not appear to be its only use. As parachuting is under control, the triangular lateral expansions on the sides of the neck assist in flight, and the gular appendage acts as a possible 'rudder'. Further, I am of opinion that the appendage plays a part in attracting insects. The appendage is flicked up and down and, at the same time, the lateral neck expansions are spread out: the three appendages forming a badly shaped T. The dorsal surface of the neck expansions is coloured like the back, but the lower is a metallic bluish green with some scattered dark spots. The appendage is intermittently brought into play when the animal is travelling up a trunk or immediately after alighting. The appendage, when fully exerted, describes almost a semicircle, from the resting to the exerted position, and when at its fullest exceeds the length of the snout, in males. During the performance the animal stands high on its forelegs. Agitation, caused by

disturbances, also make the animal perform. All three appendages are brought into play when the animal assumes a threatening attitude. The lateral expansions are spread, the gular appendage is deflexed (not to its fullest) and the mouth is opened. Actually, the whole effect produced is that of a queer-looking orchid flower. In flight the animal appears like a highly coloured grasshopper.

Breeding.—Referring to the breeding in *Draco*, the *Fauna* states, 'The young are produced from eggs, from two to five being laid at a time. These are buried in the ground'. Thanks to the kindness of Dr. M. Suter, whose guest I was during a fortnight's trip to Kanara, I was able to observe and collect some of these interesting lizards. The period of the trip extended from the 3rd to 15th September 1940. The breeding season of this lizard is undoubtedly during the monsoon months. While at Karwar, I saw many young and secured four gravid females, one of which contained large eggs in the oviducts almost ready for laying. These eggs measured 15×9 mm. The other females contained smaller eggs still in the body cavity. The normal number of eggs in a clutch appears to be four. The condition of the male genitals in mature males indicated that the animals were passing out of the breeding season.

Sexual differences.—The females are larger than the males. The gular appendage is not as long as in the males, but displays the same colouring.

Food.—The food of *dussumieri* is apparently composed largely of ants, particularly the Red Tree-Ant (*Oecophylla smaragdina* Fabr.). The stomachs of some were packed exclusively with this species.

Colouring.—In May 1939, Mr. D'Souza of our office brought in a living example which he had caught at Yellapore, N. Kanara. Apparently the colouration of this species from life has never been recorded (*vide Fauna*). Now I attempt to describe the difficult colour pattern, but this is by no means constant as it keeps changing within certain limits. The colouration, as I saw it, was as follows:—Head and dorsal portion of body (excluding parachute membrane), limbs and tail mottled with dark and light browns, buff and grey. On the nape there is a transverse ellipsoid, buffish patch. Along the vertebral column, from between the forelimbs to the region of the pelvis, there are four longitudinal narrow ellipsoid patches, the mid-dorsal patch being the largest. Each patch consists of a buffish ellipse with dark brown lineal ellipses within—these patches under certain conditions turn almost white, and the rest of the body black. The tail is irregularly banded at intervals, with the same tones as the body.

The dorsal surface of the parachute; the peripheral margin is radially streaked with thin lines of brown and buff; within this margin which has a depth of about 5 mm. it is very strongly blotched with black and gold or dull yellow, the blotches often confluent. The yellow gradually passes into the body colours. The reverse has fewer black blotches, no margin as above and the entire area suffused with pale blue. The chin and throat are metallic yellow-green with a few brown markings near the mouth,

**Measurements of* Draco dussumieri *Dum. & Bibr. in millimetres.*

Species	Sex	Date	Locality	Snout to Vent	Vent to tip of Tail	Size of Testes	Size of eggs	Remarks
D. dussumieri ...	♀	Sept. 1940	Karwar, N. Kanara	97	155	......	8	Ova in body cavity (right 2, left 2).
Do. ...	♀	,,	,, ,, ,,	93	144	......	15 × 9	Eggs in oviduct (right 2, left 2).
Do. ...	♀	,,	,, ,, ,,	91	141	......	5	Ova in body cavity (right 2, left 2).
Do. ...	♀	,,	,, ,, ,,	90	146	......	......	Abdomen damaged.
Do. ...	♂	,,	,, ,, ,,	82	125	4 × 3	......	
Do. ...	♂	,,	,, ,, ,,	84	127	......	......	Damaged.
Do. ...	♂	,,	,, ,, ,,	85	......	5 × ?	......	,,
Do. ...	♂	,,	,, ,, ,,	80	105 (B)†	......	......	,,
Do. ...	♂	,,	,, ,, ,,	83	127	4 × ?	......	,,
Do. ...	?	,,	,, ,, ,,	41	65	......	......	Young.

* Measurements taken after animals had been in spirit some days.
† (B) = Broken.

this passes imperceptibly into the bright chrome yellow of the gular appendage. The chest, abdomen, under-surfaces of the limbs and a part of the ventral of the tail are metallic blue-green. The eyes are almost black, surrounded by bluish eyelids. The inner margin of the upper jaw is strongly demarked in pearly white.

Sitana ponticeriana Cuv. Fan-throated Lizard.

A female measuring from snout to vent 45 mm. and from vent to tip of tail (broken) 55 mm. was captured at Sutgutti, 16 miles north of Belgaum, on the 5th June, 1938. Two days later she laid eleven eggs. The *Fauna* records that this species lays six to eight eggs. The average measurements of the eleven eggs is 7.96×5.76 mm. The largest measured 8×6 mm.; the smallest 7.5×6. The shape is ellipsoid, tapering somewhat towards both poles.

Calotes versicolor (Daud.) Jerdon. The Bloodsucker.

In volume xxxix of the *Journal* I described some of the habits of this lizard. With regard to the egg-laying period, the latest date on which eggs were discovered was the 22nd August (1937). A fresh clutch was unearthed in a flower pot on the 17th September, 1938. Late clutches may explain the appearance of a few immature animals after the aestivating period.

Copulatory organs.—An anatomical detail which has puzzled me much is the 'dual' copulatory organs of certain reptilian groups, namely, the lizards and snakes. One can hardly resist asking, Why are these reptiles provided with a bifid, others with a single copulating organ? Dr. Smith [*Fauna British India* (Reptilia), vol. ii, p. 4, 2nd Ed.] referring to these organs in lizards writes:—

> 'Each organ consists of a tube of erectile tissue, which can be everted like the finger of a glove. **Only one organ is inserted, but which one is immaterial, and depends upon which side the male happens to be at the time of copulation.*'

Referring to Gadow (*Camb. Nat. Hist.*, Amphibia and Reptiles, p. 499) we find the same statement: '**Only one organ is inserted at one time.*'

On the other hand we have the view proposed by Jones [*The Animal Kingdom*, p. 758, para (2025)] discussing the copulatory organs of reptiles:—

> 'The earliest appearance of copulatory organs is seen in Serpents and Lizards tribes: and in such reptiles it will be observed that **the penis is rather a provision for securing the juxtaposition of the sexual apertures of the male and female than an instrument of intromission.* The two lateral halves of the penis (or *corpora cavernosa* as we shall have to call them hereafter, when they become conjointed in the mesial line) are as yet quite separate, and placed on either side of the cloacal fissure, from which they protrude when in a state of erection, so that there appears to be two distinct organs of excitement, or, more properly speaking, of prehension; for each division, being of course imperforate, is covered with sharp spines†, **and is obviously adapted to take a firm hold of the cloaca of the female than to form a channel for the introduction of the seminal fluid.*'

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* The italics are mine.

† There are no spines in *Calotes* nor in *Hemidactylus*.

If the copulatory organs of snakes and lizards are organs of prehension, as suggested by Jones, then such prehension, to be effective, implies the use of both organs. In such lizards, as I have observed, i.e. *Hemidactylus, Calotes* and *Mabuya,* the male at first holds the female in its jaws, but the grip is released as soon as the copulatory organs are inserted. In these lizards the limbs are employed in securing a stance on vertical walls or the surface of a branch, and cannot be used for holding the female, and, once the grip of the jaws is relaxed, hold is maintained solely by the copulatory organs. In these conditions it is difficult to accept the contention that only one organ is employed; and one is inclined to the conclusion that security and effectiveness of hold depend upon the use of both organs.

Fat bodies.—Before the gonads become active there are two large, ovate-oblong, yellow fat bodies present in both sexes, one on either side of the vertebral column. With the increase in the size of the gonads there is a relative decrease in the size of these bodies and eventually become totally absorbed. In some specimens taken on the 16th June (1940) at the Tulsi Lake, the fat bodies had been absorbed though the ova were not mature, but still in the body cavity (see table). The main function of these bodies appears to be to ensure the proper development of the gonads at a time when the food supply is precarious, i.e., during the dry months when few insects are about.

Food.—In my previous paper on this lizard, I dealt with the question of food in somewhat general terms, but further observations have enabled me to give more details. The following is a list of the stomach contents of several lizards:—

Dysdercus cingulatus Fb. These bugs though very common at certain times of the year are only eaten in small numbers.

Cremastogaster sp. *Camponotus compressus* Fb.	Both species are eaten in large numbers, and in the dry months appear to form the main source of food, particularly, *Cremastogaster* sp.

Plagiolepis sp. (*Hymenoptera*). This ant is very common in Salsette Island and at first looks very much like *Oecophylla smaragdina* Fabr. but the former is slightly smaller and does not bite, while the latter bites viciously.

Scolopendra sp. occasional.

Parasa lepida Gam. (*Limacodidae*). Three larvae of this moth were taken from a single *Calotes*. This find is interesting in that these larvae are armed with strongly irritant spines which are sufficient to deter most enemies. The spines are believed to contain formic acid.

Small *Coleoptera* are taken in plenty, and various caterpillars frequently. Numerous other insects were found but too far decomposed to identify with certainty.

Apart from the above list I have found the seeds of a grass, *Coix Lachryma-Jobi* Linn. These seeds were evidently taken in error for insects on account of the peculiar shape. Mr. H. Ali informs me that he found the fruit of *Lantana* in the stomach. Other curious finds were a piece of clear glass about 6 mm. square:

Measurements of Calotes versicolor *in millimetres.*

Species	Sex	Date	Locality	Snout to vent	Vent to tip of Tail	Size of Testes	Size of eggs	Remarks
Calotes versicolor.	♂	28–4–40	Andheri, Salsette Isl.	122	290	11 × 7	......	Fat bodies large. Lungs infested with Nematodes.
Do. ...	♂	29–4–40	,, ,, ,,	118	277	14 × 7	......	Fat bodies reduced.
Do. ...	♂	29–4–40	,, ,, ,,	117	274	9·5 × 5	......	Fat bodies large.
Do. ...	♂	29–4–40	,, ,, ,,	125	276	12 × 6·5	......	,, ,,
Do. ...	♂	26–5–40	,, ,, ,,	128	272	14 × 9	......	Fat bodies fairly large. Lungs heavily infested with Nematodes.
Do. ...	♂	1–6–40	,, ,, ,,	139	293	12·5 × 8	......	Fat bodies considerably reduced. Lungs slightly infested with Nematodes.
Do. ...	♂	2–6–40	,, ,, ,,	126	291	15 × 9	......	Fat bodies absent.
Do. ...	♂	2–6–40	,, ,, ,,	118	270	14 × 8·5	......	Fat bodies reduced. Lungs infested with Nematodes.
Do. ...	♂	9–6–40	,, ,, ,,	129	126 (B)*	17 × 9	......	Fat bodies absent.
Do. ...	♂	9–6–40	,, ,, ,,	118	275	14 × 7·5	......	Fat bodies reduced.
Do. ...	♂	9–6–40	,, ,, ,,	121	265	14 × 8	......	Fat bodies small. Lungs slightly infested with Nematodes.
Do. ...	♂	9–6–40	,, ,, ,,	119	272	15 × 7·5	......	Fat bodies absorbed. Lungs heavily infested with Nematodes.
Do. ...	♂	16–6–40	Tulsi Lake ,, ,,	137	310	15 × 9	......	Fat bodies absorbed. Lungs infested with Nematodes.
Do. ...	♂	16–6–40	,, ,, ,,	109	268	12 × 6	......	Fat bodies absorbed. Lungs infested with Nematodes.
Do. ...	♀	30–4–40	Andheri, ,, ,,	89	210	......	2	Fat bodies large. Ova in body cavity.
Do. ...	♀	30–4–40	,, ,, ,,	92	132 (B)	......	2	,, ,, ,, ,,
Do. ...	♀	30–4–40	,, ,, ,,	83	193	......	1	,, ,, ,, ,,
Do. ...	♀	30–4–40	,, ,, ,,	104	240	......	3	,, ,, ,, ,,
Do. ...	♀	15–5–40	,, ,, ,,	93	235	......	4	Fat bodies reduced. ,, ,,
Do. ...	♀	26–5–40	,, ,, ,,	88	202	......	6	Fat bodies large. ,, ,, (right ovary 6, left 6).

Do. ...	♀	26–5–40	,, ,, ,,	97	230	......	8·5	Fat bodies small. Ova in body cavity (right ovary 7, left 8).
Do. ...	♀	26–5–40	,, ,, ,,	99	101 (B)	......	12·5 × 7·5	Fat bodies small. Eggs in oviducts (right 8, left 6).
Do. ...	♀	26–5–40	,, ,, ,,	118	145 (B)	......	14·5 × 8	Fat bodies small. ,, ,, (right 11, left 12).
Do. ...	♀	1–6–40	,, ,, ,,	106	235	......	12·5 × 7	Fat bodies small. Eggs in oviducts (right 9, left 8). Abdomen infested with large Nematodes.
Do. ...	♀	16–6–40	Tulsi Lake ,, ,,	86	101 (B)	......	7	Fat bodies absorbed. Ova in body cavity (right 6, left 5).
Do. ...	♀	16–6–40	,, ,, ,,	89	230	......	9	Fat bodies absorbed. ,, ,, ,, (right 12, left 11).
Do. ...	♀	16–6–40	,, ,, ,,	82	210	......	5	Fat bodies absorbed. ,, ,, ,, (right 5, left 5).

*(B) = Broken.

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Do. ...	♂	29-4-40	,, ,, ,,	125	276	12 × 6·5	......	,, ,,
Do. ...	♂	26-5-40	,, ,, ,,	128	272	14 × 9	......	Fat bodies fairly large. Lungs heavily infested with Nematodes.
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Do. ...	♂	2-6-40	,, ,, ,,	126	291	15 × 9	......	Fat bodies absent.
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Do. ...	♂	9-6-40	,, ,, ,,	121	265	14 × 8	......	Fat bodies small. Lungs slightly infested with Nematodes.
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Do. ...	♀	30-4-40	Andheri, ,, ,,	89	210	......	2	Fat bodies large. Ova in body cavity.
Do. ...	♀	30-4-40	,, ,, ,,	92	132 (B)	......	2	,, ,, ,, ,,
Do. ...	♀	30-4-40	,, ,, ,,	83	193	......	1	,, ,, ,, ,,
Do. ...	♀	30-4-40	,, ,, ,,	104	240	......	3	,, ,, ,, ,,
Do. ...	♀	15-5-40	,, ,, ,,	93	235	......	4	Fat bodies reduced. ,, ,,
Do. ...	♀	26-5-40	,, ,, ,,	88	202	......	6	Fat bodies large. ,, ,, (right ovary 6, left 6).
Do. ...	♀	26-5-40	,, ,, ,,	97	230	......	8·5	Fat bodies small. Ova in body cavity (right ovary 7, left 8).
Do. ...	♀	26-5-40	,, ,, ,,	99	101 (B)	......	12·5 × 7·5	Fat bodies small. Eggs in oviducts (right 8, left 6).
Do. ...	♀	26-5-40	,, ,, ,,	118	145 (B)	......	14·5 × 8	Fat bodies small. ,, ,, (right 11, left 12).
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Do. ...	♀	16-6-40	,, ,, ,,	89	230	......	9	Fat bodies absorbed. ,, ,, ,, (right 12, left 11).
Do. ...	♀	16-6-40	,, ,, ,,	82	210	......	5	Fat bodies absorbed. ,, ,, ,, (right 5, left 5).

*(B) = Broken.

a valve of a bivalve shell. As there is no muscular pyloric region in *Calotes,* hard substances would serve no useful purpose, hence the only conclusion is that hard substances, such as these, are swallowed in error.

Parasites.—In my paper referred to above, I mentioned the occurrence of some internal parasites taken from *Calotes,* but could not mention them specifically at the time. Since then some of the worms were identified. They are as follows:—

Polydelphis rotundicaudatus (v. Linst., 1904) Baylis, taken from the stomach.

Strongyluris calotis Baylis & Baubney, infesting the rectum.

A Pentastomid was taken from the lungs, one in each.

On the 26th May 1940 I removed 65 small worms, similar to *Strongyluris,* from the lungs of a single male—40 in one and 25 in the other! Another male (on 16-6-40) yielded 55 Nematodes, 36 in one lung and 19 in the other! In spite of such heavy infections the lizards appeared healthy and behaved quite normally. The upper half of the lungs was seriously inflamed and the inner walls of the lower half were covered with nodular outgrowths. The Nematodes lie free in the lung cavity. It does seem curious that though these lizards are often heavily infected, externally, they appear healthy and normal. On the 1st June (1940) I recovered seven large worms measuring 60 mm. long from the body cavity of a female. These worms moved among the viscera and the eggs. Though the animal harboured these worms she seemed perfectly fit and contained 17 eggs in the oviducts.

Besides the above-mentioned parasites the following have been recorded from *Calotes versicolor* (*vide* Baylis, *F.B.I.* Nematoda):—

'*Ascaris*' *brachyura* (v. Linst., 1904) from Ceylon.

Thelaudros maplestoni (Chatterji 1930) from Burma and Ceylon.

Conispiculum flavescens (Castellani & Willey, 1905) India & Ceylon.

Thubunaea dactyluris Karve 1938, India.

Physaloptera archari Mirza 1935 (=? *P. paradoxa* v. Linst. 1908), India.

Calotes rouxi Dum. and Bibr. The Forest Bloodsucker.

Colour.—The Forest Bloodsucker is smaller than the common Bloodsucker (*C. versicolor*). In non-breeding garb it may be mistaken sometimes for juveniles of *versicolor,* but in the breeding season it is very distinctive. At that season both males and females are black in tone throughout, except for the head and a narrow patch along the vertebral column which are bright scarlet, the scarlet gradually lessening in intensity posteriorly. In the females the scarlet markings are far less pronounced than in the males. In this phase of colouring the animal does not look unlike some bark fungus from a distance. In the non-breeding season the general colouring consists of sober browns, but like other lizards they are able to change colour considerably according to the ground they are on. On the top of the head there are four characteristic black dots in both sexes throughout the year. The breeding colours are

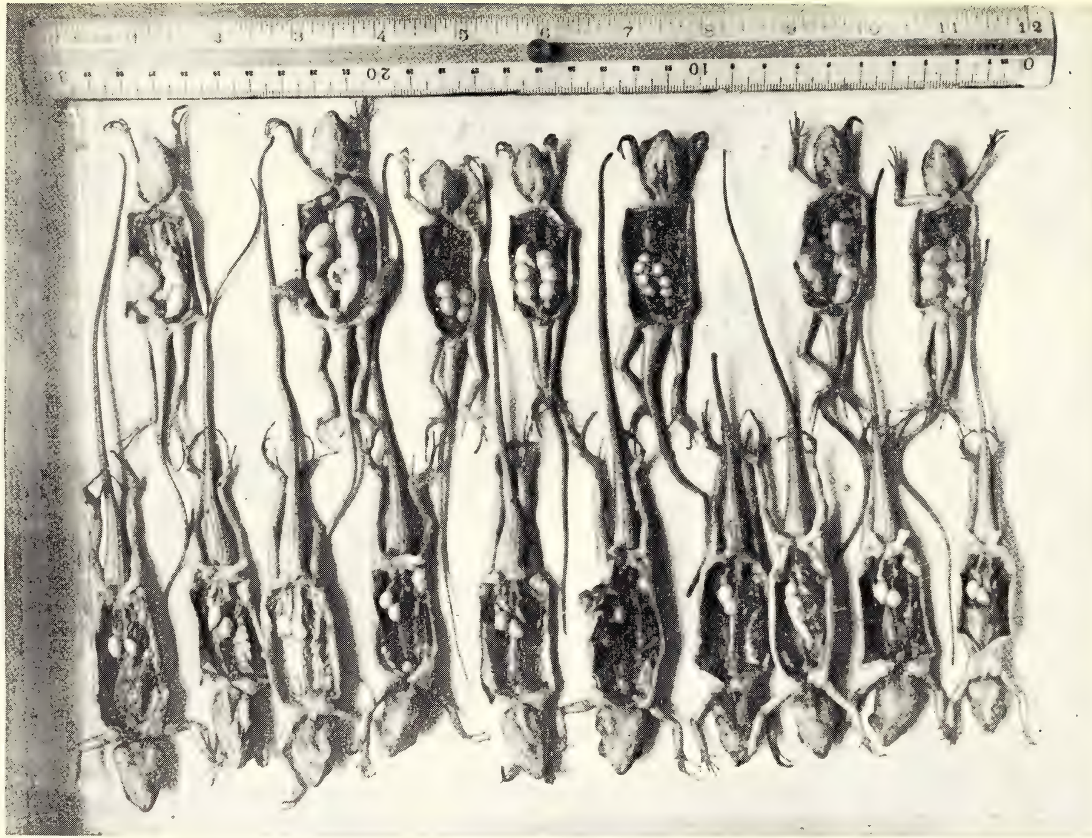

Photo: *C. McCann.*

Dissections of the Forest Bloodsucker (*Calotes rouxi* Dum. & Bibr.) showing the condition of breeding organs. (Top row females; bottom males).

Photo : *C. McCann.*

The Common Skink (*Mabuya carinata* Boulenger) at home.

controllable and their intensity depends on the temperament of the animal at the time. Under disturbed conditions, such as handling, the colours almost disappear.

Sexual difference.—The males are larger than the females.

Habits.—Dressed in the contrasting breeding colours the males sit watching for females, and from time to time bob their heads and shoulders up and down just as the common Bloodsucker does. This form of display possibly serves a dual purpose; one as a challenge to other males who respond in the same manner before approaching each other to fight; and the other, to distinguish the females which do not adopt the same performance. Fights between males are not uncommon and some lizards may be seen with scars. Rival males may be seen going from tree to tree to chase one another away. The courtship is apparently short; the male will chase a female round a trunk, she will dodge, often arch her back and meet the male in an 'aggressive' attitude, then suddenly take to flight again. This sort of play continues for a time before actual copulation takes place. Many of the habits of the species are not unlike those of the Bloodsucker (*C. versicolor*).

These lizards spend much of their time low down on the trunks of trees coming to the ground frequently to catch insects. They are inhabitants of deciduous forests. Their numbers have been considerably reduced in Salsette since the wholesale deforestation of certain parts of the island. Owing to this state of affairs large numbers were congregated where a few trees were available in June 1939, but since then, the trees have been demolished!

Breeding Season.—The breeding season commences during the hot weather, i.e. the middle of May and reaches its height in June when the eggs are laid. The clutch numbers from 4 to 9, but 6 or 7 appears to be the general rule. The accompanying table gives the size of the eggs.

In Kanara the breeding season appears to be somewhat later than in Salsette Island. While at Karwar during the early part of September (1940) I noticed several males in breeding colour and secured a single female with fully matured eggs in the oviducts. At the same time there were a number of young about.

Food.—This lizard is insectivorous. On one occasion I found it feed on a red Pyrrhocorid bug. The bugs are avoided by most other lizards. At the breeding season the bugs appear in large numbers.

FAMILY: *Scincidae*: Skinks.

Mabuya carinata Boulenger. The Common Skink.

The Common Skink, is often referred to as the 'Snake-leader' or 'Snake-ant (or aunt)'[1]—Snake-leader, because popular belief has it that this inoffensive creature is a forerunner of snakes. There is, of course, no real foundation for this belief, but it must be remembered, that this lizard, like so many others, forms the chief

[1] 'Snake-ant' is a literal and mutilated translation of the Marathi name *Surpā chi mousi* (=snake's aunt).

Measurements of Calotes rouxi *in millimetres.*

Species	Locality	Date	Sex	No. of Pores	Size of Testes	No. of Eggs	Size of Eggs	Head & Body	Tail	Remarks
Calotes rouxi Dum. & Bibr.	Kanari Caves, Salsette Isl. ...	8-6-39	♂	...	7 × 4	...	...	72	143	
Do. ...	Do. ...	Do.	♂	...	8 × 4	...	...	65	128	
Do. ..	Do. ...	Do.	♂	...	7 × 4	...	...	66	143	
Do. ...	Do. ...	Do.	♂	...	7 × 3	...	...	65	131	
Do. ...	Do. ...	Do.	♂	...	7 × 5	...	...	68	131	
Do. ...	Do. ...	Do.	♂	...	7 × 4	...	...	71	127	
Do. ...	Do. ...	Do.	♂	...	7 × 5	...	...	67	(broken)	
Do. ...	Do. ...	Do.	♂	...	7 × 4	...	...	71	132	
Do. ...	Do. ...	Do.	♂	...	7 × 4·5	...	...	66	118	
Do. ...	Do. ...	Do.	♂	...	6 × 4	...	...	61	98 (broken)	
Do. ...	Do. ...	Do.	♀	...	...	6 + M	10·5 × 6	62·5	128	Eggs in uteri.
Do. ...	Do. ...	Do.	♀	...	...	6 + M	12 × 6·5	68	136	Do. almost mature.
Do. ...	Do. ...	Do.	♀	...	...	6 + M	12 × 6	60	119	Do. Do.
Do. ...	Do. ...	Do.	♀	...	..	6 + M	7·5	58	122	Egg in body cavity, Spherical
Do. ...	Do. ...	Do.	♀	...	...	6 + M	7	57·5	111	Do.
Do. ...	Do. ...	Do.	♀	...	...	4 + M	7	57	109	Do.
Do. ...	Do. ...	Do.	♀	...	...	9 + M	4	60	(broken)	Do.

M = many small eggs.

Photo: *C. McCann.*

A. The Common Skink (*Mabuya carinata* Boulenger).
B. The Little Skink (*Mabuya macularia* Boulenger).
E. eggs; O. ova; Ov. oviduct.

food of certain snakes, such as the Wolf-Snake (*Lycodon aulicus*), which is a frequent inhabitant of dwellings. There is, in the Society's collection, an interesting specimen of a *Lycodon,* which had eaten a skink 'too large' for it, with the result that the skink forced all four legs through the body wall of the snake giving it the appearance of some prehistoric monster.

In district bungalows this lizard is a frequent visitor, where it may be seen gliding about in corners and under furniture in search of insects. If not molested it often becomes quite tame, paying no attention to the inmates of the house. In forests it is frequently seen streaming in and out of fallen leaves, and under stones and rocks, its snake-like head peeping out now and again, looking very 'snakish' indeed. In the early hours of the morning, particularly in the cold weather, it may often be seen basking in the sun, either on rocks or on the trunks of trees (it never climbs into the thin branches). When possible, it will also climb on to the roof and hunt among the tiles or thatch.

In habit it is purely diurnal, resting at night in any suitable place. They are so attached to their resting places that they return to them in spite of disturbance. In my bungalow one always returned to a cloth-covered box, where it slept under the cloth. Mr. C. King, a neighbour of mine, always had one in his bed every night during the monsoon months (at no other season). The lizard would either get under his pillow or under the folded blanket at the foot of the bed. Here it would return night after night in spite of being rudely ejected at bed time. I can vouch for this statement as I have seen the lizard in question on many occasions.

The young are numerous among the fallen leaves during the months of June and July.

It is perhaps unnecessary to say that this creature is perfectly harmless and even when handled rarely bites, but old beliefs die hard. In captivity it does well and lives for several years. The food consists chiefly, if not exclusively, of insects. I have kept several in captivity, feeding them largely on cockroaches, when other insects were not available. Recently I had two large lizards in the same box. I put in a large green mantis, one of them got hold of it and dusted it vigorously on the floor. The other tried to join in the meal but each time the second lizard approached, the one with the mantis would turn its hind portion towards the other to ward it off. After the mantis had been beaten to pulp it was swallowed. The skink drinks water occasionally (noted in captivity).

Mabuya macularia Boulenger. The Little Skink.

This is quite common in the Island of Salsette, and may at first glance be mistaken for a young *M. carinata.* A pair was found on the 22nd June (1935) in copulation. I was only able to secure the female. It measured from snout to vent 48 mm.; vent to tip of tail 59 mm. On dissection it was found to contain four eggs, approximately 5 mm. in diameter. On 8th June 1939, I secured a female measuring from snout to vent 52 mm., tail 74 mm.

She contained three, almost mature eggs in the uteri (2 in the right and one in the left) measuring 9×6 mm. Besides these large eggs there were numerous other small ones in the body cavity. The normal clutch appears to be four.

It is more of a forest dweller than the Common Skink.

FAMILY: *Varanidae*: The Monitors.

Varanus monitor (L.) The Common Indian Monitor.

The Common Monitor is frequently referred to by many Europeans and Anglo-Indians as the Iguana. It is well known that true Iguanas are American, though *Chalaradon* and *Hoplurus* occur in Madagascar. To most Indians it is known as *Gor, Gorpad,* or variations of the name. The young, owing to its very different markings from the adult, is referred to by other names, one of which is the mythical *bis-cobra.* In ancient wars and in criminology in India this monitor is said to have figured frequently, as a means of scaling walls. A rope was tied round the waist, and the animal allowed to ascend the wall. Once over, pulling on the rope forces the animal to secure itself. The owners would then climb up the rope. The well-known Marathi surname, *Gorpade,* arose from the belief that some ancestor of the family used this lizard effectively for scaling a fort wall. Be this as it may, to my mind this story is quite possibly true. From my own experience, I have found it exceedingly difficult to extract a monitor from a crevice once it has wedged itself in. The following will suffice to show the great strength with which it can hang on:—In Mt. Abu (5,000 ft.) I once caught one of these lizards just as it was disappearing into a crevice. It was about 30 inches long. Only the tail remained out. I hung on to it with my feet planted against the rock, I pulled and pulled, but the animal would not give way an inch. As I was close to our bungalow I called for assistance and a rope. The rope we managed to tie just ahead of the hind limbs. With the aid of three servants I tried again to dislodge the animal but it would not move. As this plan failed, I got some straw, lit it, and put it near the tail, thinking the heat would make it release its hold, but no. Later I discovered that I had unintentionally burnt the tail a bit. In spite of this it still held out. Eventually, I slackened the rope slightly and as the animal tried to go further in, I suddenly jerked the rope and out it came. It stood at bay until captured.

As the monitor has such extraordinary strength, is it any wonder that it was used as a means of scaling? One man's weight would be nothing, once the animal wedged itself into a crevice, or got down a hole. After such experiences as I have had with this lizard, I, for one, cannot discredit the probable use of these lizards as an aid to scaling rough walls. Anyone who has handled a fair sized, vigorous animal must have been impressed with its extraordinary strength.

Though this monitor is perhaps commoner in dry districts, it is also found in dense forest. It swims and dives well, and often takes to water for safety, and remains submerged for a considerably

long time. When pursued over flat ground it runs exceedingly fast, but for a short distance only; it soon shows fatigue and stands at bay when overtaken, blows itself up, hisses and lashes out with its tail. Having recovered itself, it takes to flight once more at the first opportunity. The monitor climbs trees with great ease, and may sometimes be seen up the tallest palms in search of birds' nests. The young appear to climb more easily and oftener than the adults.

Young.—In Salsette most young appear during the hot weather and the early part of the monsoon. Only once have I found eggs with well-developed embryos. Unfortunately, I did not keep a record at the time. A recently hatched young was caught by Mr. D. B. Barretto at Kurla in the month of February 1939. On the 24th May (1939) I caught an older one at Andheri. It was perhaps three weeks to a month old. The young are very variable in colouring and are able to modify their colour to a certain extent, generally they are strongly banded. These markings disappear with age. Growth during the early period is fairly rapid, but beyond a certain size it slows down.

Food.—The food is varied and consists of rats, birds, frogs, and perhaps any animal that can be overpowered. In captivity, adults live for many years when fed on raw meat, rats, birds and eggs. The food is generally swallowed whole, but when it is too large it is torn to pieces with the aid of the forelimbs. Living prey is soon killed by vigorous dashing against the ground. In the process of swallowing, if portions of the prey protrude, the animal brushes them into its mouth by rubbing the jaws against the ground.

The Common Monitor is purely diurnal. Captive specimens, due probably to confinement, get extremely fat and frequently suffer from a fusion of the vertebrae.

The Monitor is often destructive to poultry, feeding both on the eggs and the birds. The meat is eaten by the local people.

ORDER: ECAUDATA.

FAMILY *Ranidae*: Frogs and Toads.

Rana hexadactyla Lesson. The Six-toed Frog.

In volume xxxvii (p. 742) of the *Journal* I mentioned the occurrence of this species in the Bombay Presidency, but unfortunately omitted to record the measurements. They are as follows: females, from snout to vent 60 mm. and 65 mm.; no males were obtained.

On the 12th March 1939, Mr. H. Ali and I secured a male and female living in one of the dry cisterns at the Kanari Caves, Salsette Island. These two specimens I kept in an aquarium. As the female showed signs of being gravid, I lived in hope of being able to trace the life cycle, but it escaped just before the monsoon broke. It was last seen in the aquarium on 30-5-39. The male called frequently both day and night. The call is not unlike that of *R. cyanophlictis*. In the note referred to above, I mentioned, 'It is curious that these frogs should be gravid at this time of the

year,' (25-2-34) and concluded by saying, 'they may possibly breed all the year round'. The present instance indicates that though the females may be gravid early in the year the eggs are not laid till the beginning of the rains, as do most other frogs.

Together with this species we also found *R. tigrina, R. leithii,* and *R. malabarica,* all living together under the same stones.

Rana cyanophlictis Schneid. The Skipper.

During the latter part of May and early June I have often taken specimens full of ova. This indicates that the breeding season commences with the monsoon. Two females measured 62 mm. and 59 mm., respectively. The males are smaller. Amplexus takes place in lakes and not in small puddles as in the case of *R. tigrina.*

Rana tigrina Daud. The Bull-Frog.

Voice.—About the middle of May 1938, I heard a single Bull-Frog calling. As it was some time before the rains actually broke, it seemed rather unusual. Then again, I heard several croaking in the fields, at Andheri, during the month of August (1938), long after the general breeding season was over. Usually croaking in this species ceases after amplexus which occurs during the first week, or couple of weeks, of the rains, depending on weather conditions. The question naturally arises : Are these 'croakers' late comers in the season, or are they males that were unsuccessful in finding mates during the general breeding period? Whichever the reason, the sexual urge must have still lasted, though the frogs had lost their yellow garb—a characteristic of males during the breeding season. Perhaps the croaking is intimately associated with the sexual urge and the condition of the testes, the croaking only ceasing after the testes are voided, or in the case of unsuccessful males till the contents have been absorbed and diminished to non-breeding condition. Here I must leave this interesting point.

Colour.—In my paper, *Notes on Indian Batrachians (J.B.N.H.S.* xxxvi, 158), I dealt at some length on the life-history of the Bull-Frog. In that paper I made several references to the remarkable colour displayed by the males at the breeding season, but did not venture to offer any explanation for it, nor do I intend to do so here, but merely record some further observations. On page 160 of the paper I wrote, 'Another curious point arises here. The males which remain above ground during the dry season, according to my observations, retain their normal colouring. Specimens kept in captivity by me exhibited no change . . . ' In the light of further observations one is frequently compelled to alter a previous statement, and this I must do here. During May 1937, I collected several adult specimens at the Powai Lake, for dissection and observation. Around the lakes in Salsette, this frog is found all the year round.

An examination of the specimens caught on the 7th May showed that the males were in the 'normal' attire—brown—but the insides of the forelegs were suffused with yellow, and the same tint extended along the flanks of the thighs. Dissection revealed that the

Photo : *C. McCann.*

Two couples of the Bull Frog (*Rana tigrina* Daud.) taken in amplexu, A and B sexually mature; C and D immature; E. eggs; O. ovaries; T. testes.

testes were distinctly enlarged, almost in breeding condition. Females were laden with almost mature ova. Specimens collected on the 21st May showed no appreciable difference from those collected earlier. But on the 24th May the males showed distinct signs of becoming yellow and by the 26th had become completely so. The yellow colouring appears to be under control, and the animal is able to vary it under certain conditions. A yellow frog, if handled, will change to greenish brown, but when at rest again will return to the yellow phase. Disturbances react on the colouring of the animal.

In a subsequent paper on the Bull-Frog (*Precocity in young Bull-Frogs, J.B.N.H.S.* xxxviii, 409), I pointed out that young males also turn lemon yellow at the breeding season, in spite of the fact that the genitals are immature. It seems clear from these observations that the condition of the genital organs, namely, whether they are in breeding condition or not, does not directly influence the colouring of the males at the breeding season, if at all.

A breeding male in amplexus measured from snout to vent 149 mm.; testes 20 mm. long. A breeding female 122 mm. Non-breeding male in amplexus: snout to vent 88 mm., testes 11.5 mm.; female 76 mm.

Rana rufescens Boulenger. The Rufescent Frog.

A female measuring from snout to vent 31 mm. and containing almost mature ova was taken on the 10th June 1938, at the Gersoppa Falls. Its general colouring was brick-red almost throughout the dorsal surface, and a slight mottling on the hind portion of the thighs. The ventral surface was greyish-white. Other specimens taken at the same time varied from light brown to dark brown with hardly any indication of the brick-red.

Rana leithii Boulenger. Leith's Frog.

On the night of 10th June 1938, a female containing almost mature ova was taken in the compound of the Gersoppa Bungalow (British side). It measured from snout to vent 37 mm. A curious point about it was that at some time she had received a severe abdominal injury which tore open her left flank near the base of the foreleg for about half the distance to the middle of the abdomen. The wound was an old one and had healed up by the formation of a translucent stretch of skin over the once gaping area. Through this 'window' the ova could be seen easily. The piece of flesh which had been torn out at the time of the accident now formed a conical protuberance adhering to her side.

On the 12th March 1939, Mr. H. Ali and I secured several specimens in a cistern at the Kanari Caves, Salsette. Here the frogs were living under stones in the dry cisterns. In this situation the animals were almost black in colour, corresponding with the dark rock of the cistern, but later assumed a sandy colour.

On the 6th April 1939, I caught several specimens which were living under stones and among leaves in the dry bed of the stream

leading to the Lingmala Falls, near Mahableshwar (4,000 ft.). In this locality the animals were slate-black with just a slight indication of marbling, but later became sandy in tone.

These three records constitute a further extension of the range of this species. The type came from Matheran (3,000 ft.). Since then it has been found at Khandala, 1,600 ft., Poona District; Gersoppa Falls, > 1,800 ft., N. Kanara District; Kanari Caves, 1,300 ft., Salsette Island, and Lingmala Falls, 4,000 ft., near Mahableshwar.

Rana malabarica Dum. and Bibr. The Fungoid Frog.

After years, I was able to fix the author of a very peculiar metallic call in the Salsette jungles. It was made by this species, and may be said to be the breeding call. It can only be likened to the noise made by a tin rattle. It is audible a long way off, but as soon as one tries to locate it, though ever so near, it suddenly ceases—the frog has spotted the intruder and stopped.

In a former bungalow at Andheri several of these frogs took up their residence in a corner of the house, both during the rains and the dry weather. They would come out at dark and return with daybreak. They would frequently call on dull days and could be induced to do so repeatedly with a tin rattle, which imitated their call very closely. The cook slept in the same room and frequently complained of being disturbed during the night, either by calls of those that had not left, or because they jumped on him while he was asleep. He had orders not to kill them; so, frequently, there was a search during the night, and the frogs, when discovered, were rudely shot out into the compound. Naturally they returned later—such forcible ejections did not disturb their 'homing instinct'!

Breeding.—The frogs are evidently late breeders as I have taken females with ova in July. A breeding male measured from vent to snout 51 mm.; testes 6 mm. A breeding female 62 mm. The males are smaller than the females.

Rhacophorus maculatus Boulenger. The Chunam Frog.

In volume xxxvi, p. 172 of the *Journal,* I described some phases from the life-history of the Chunam Frog (*Rh. maculatus*). On page 172 I wrote, 'It appears at the break of the rains,'. This sentence must be modified in the light of further observations. The statement is certainly true of animals living under unfavourable conditions, but near perennial water and in houses, where water is at hand, they may be seen all the year round.

In my bungalow, at Andheri, this frog is a common resident throughout the year, except for a brief period during the rains, but even then it sometimes comes in. At the break of the rains they go afield to return when the rains stop and conditions are too dry outside. As many as six or seven reside with us annually. During the day, in the dry weather, they hide in vases, among clothes, behind bottles and the like with the limbs drawn up under the body as close as possible. Two regularly hide between the battens of my cot! The resting places are more or less regularly occupied, but sometimes two or three places are selected and these

are occupied on different days. Once their haunts are discovered one is sure to find them there. As soon as it is dark they emerge and first of all make for places where they are likely to get water. In such places they sit for a considerable time absorbing water under the skin, before starting on the night's adventures. Early morning, just before it gets light, they return to their respective retreats, but belated frogs, like nocturnal revellers, are not uncommon.

Before proceeding further, I would like to make a few remarks on the peculiar habit of absorbing water under the skin. It is well known that frogs do absorb water through the skin, what is more, they are also able to breathe through the skin! but in this species it appears to be developed to a remarkable degree. When the animal first emerges from its retreat it appears thin, but after a time at the water supply it has increased in bulk. The water accumulates partly under the abdomen, and partly under the skin between the hind legs, the spine forming a dividing line between the two 'reservoirs'! As soon as sufficient water has been absorbed, the animal moves off. In this case we see a special provision for water transport for the next twenty-four hours during the dry season! Hence, perhaps it is that this species is able to remain active throughout the year in favourable localities. I have not observed this provision in any of our terrestrial species. During the rains such a provision would of course, be unnecessary.

On arrival at the diurnal retreat, each frog goes through a process of 'self-massage', a somewhat ludicrous performance. The head is first rubbed down from the top over the snout, by the forelegs, and then down the throat and thorax as far as the limbs will reach. This is followed by a 'massage' of the back, flanks and abdomen, by the hindlegs. The hindlimbs then massage one another. When all this 'toilet' is over, the limbs are collected under the body and the frog 'retires'. I have tried to figure out the reason for this performance and can only ascribe it to the possibility that the animal tries to clear its body of foreign matter adhering to its skin, perhaps also, an even coating of slime, when dry, acts as a sort of film, to prevent further evaporation of moisture.

During the resting period, the body looks like a large chrysalis and the animals are very reluctant to move, even when disturbed. It takes quite a lot of provocation to make them jump. The pupils are reduced to a narrow horizontal slit, scarcely wider than a fine silk thread, but when on the move at night, the margins of the pupils coincide with the margins of the eyes—hence the entire eye appears black. Though, generally speaking, the size of a pupil is automatically controlled by the intensity of the prevailing light in most animals, in this frog, I have noticed that light is not entirely the controlling factor, but also the activity of the animal at the time. I have often seen 'late-comers' in bright daylight with the pupils fully dilated. Only on assuming the resting attitude do the pupils begin to diminish in size.

Further, close observations of several animals, both during the night and during the day showed the following results. At

night, when they leave their resting places the pupils gradually enlarge to full size, even in bright lamp light, but when they sit about, in the resting attitude, for hours, as they are wont to do, in the same place, the pupils become mere slits once more. When I have found them in this condition, I gently ran a pin-point over the skin, at once the pupil began to open slightly, with a little harder treatment the pupils expanded still more, but as soon as the animal became active and jumped about the pupils opened to the fullest. Even the light of a powerful electric torch had no effect. During the day, similar experiments evinced the same behaviour, except that the pupils in bright sunshine did not open to their fullest, but about half to three quarters. Hence it appears that the dilation of the pupils is closely associated with the activity of the animal and not entirely with the intensity of light.

A frog that lived behind some books on my writing table got on the wrong side of a pane of glass on its way 'home'. It made frantic efforts for several minutes to get through, as it could see its usual haunt, but the window-pane baffled it completely. It climbed up and down the pane, tried to force its head through, but eventually jumped on a neighbouring chair and thence to its usual retreat.

During the cold weather, though the frogs were about the house every night, they did not appear to be as active as when the weather got warmer. In the winter season they often sit about for hours in the same spot in a 'semi-dose'. Incidentally, the chance of finding insects is then remote. Towards the middle of April the males in the house began to call now and then. The calling became more frequent with the approach of the rains. No frogs called outside. As soon as the rains commenced the frogs in the house disappeared. *Rh. maculatus* is heard occasionally throughout the rains in the neighbouring vegetation. On the 15th September (1938) the first frog was seen again in the house, the rains were diminishing. This arrival was followed by others as the season wore on and once more we had our full complement of tree-frogs.

Food.—The food, like that of most frogs consists chiefly of insects, but certain insects are definitely avoided, such as *Cantharids*, garden bugs, water beetles, fire-flies, and some carabids. In common with its fraternity, it will only 'lap up' moving objects. Once I saw a Chunam Frog 'lap up' a fire-fly, the very next moment it 'spat' it out; a peculiar performance. The frog flapped its tongue out with the insect adhering to it, backed a bit, dragging its tongue along the floor till the insect was free of it. This experiment did not teach it that the fire-fly was distasteful, for a little later as the insect moved off the frog lapped it up again. The same ludicrous performance was repeated as before and the insect released. Eventually it left the fire-fly to go its way.

Microhyla ornata Boulenger. The Black-throated Frog.

This frog is not uncommon at Andheri during the rains. Even during the dry weather it may be found occasionally in the earth of watered flower-beds. On the 11th July (1937), I secured a gravid

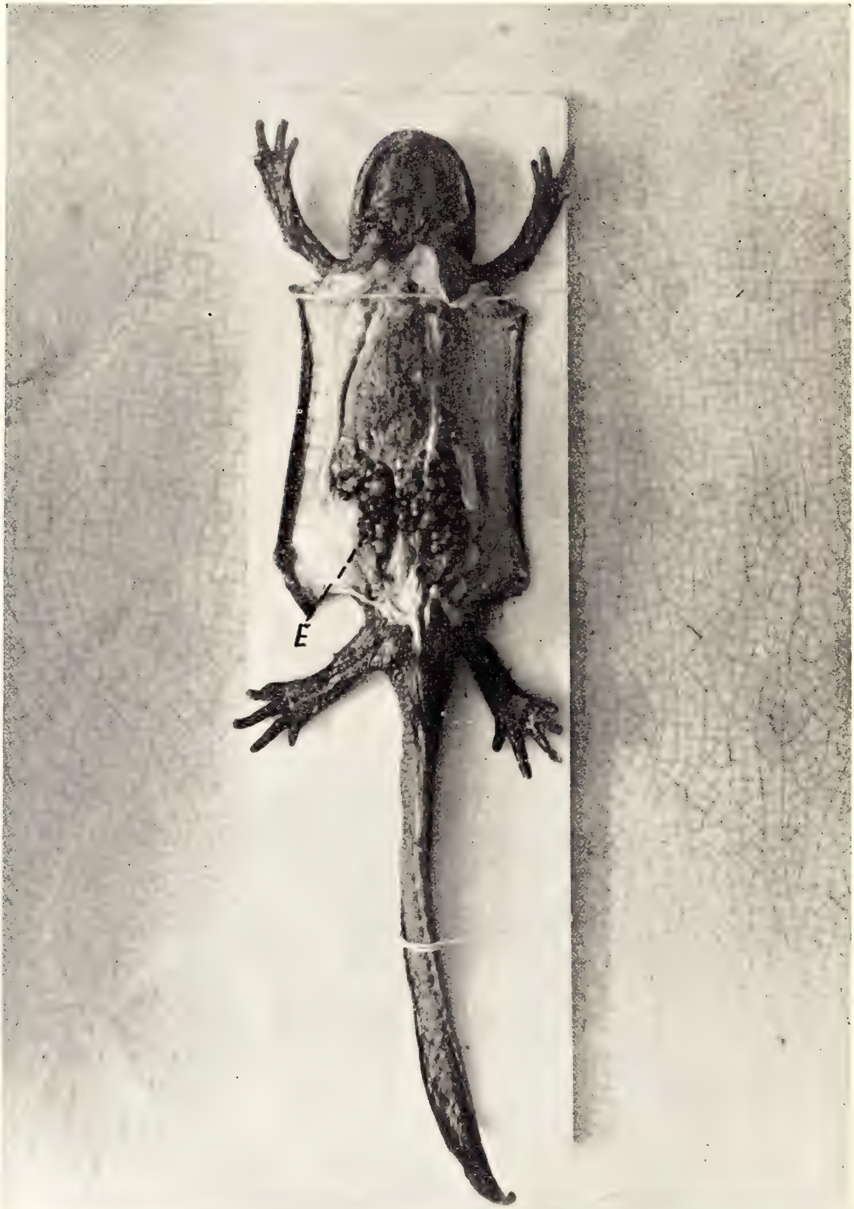

Photo : *C. McCann.*

The Indian Salamander (*Tylototriton verrucosus* Anders.)
E. eggs.

female measuring 20 mm. from snout to vent. Another female caught on the 5th June 1940 at Andheri showed the ovaries to be active, but the ova were far from mature, were creamy yellow and did not occupy the entire abdominal cavity as in the previous specimen with almost mature, pigmented, ova. This apparently indicates a later breeding season than is the case with other frogs. In my paper in the *Journal* (xxxvi, p. 177) I wrote, 'The number of eggs laid is comparatively few—30-40'. This in the light of the specimen mentioned above must be modified as it contains a lot more—perhaps a couple of hundred at a rough estimate. As the mature specimen I have is the only one, I cannot give the exact number without destroying it.

An examination of the stomach contents of the animal caught on the 5th June (1940) indicated that the animal fed on small *Coleoptera* and small ants.

Philautus bombayensis. The Bombay Philautus.

This species I was surprised to find some years ago during the dry months in fairly large numbers under stones in the bed of the stream leading to the Lingmala Falls, near Mahableshwar, 4,000 ft. It is most elusive during the rains, when it is more often heard than seen. During the Easter holidays of 1939 (April) I visited the same area and again found them to be very plentiful. The colour and markings are very varied.

ORDER: CAUDATA

FAMILY: *Salamandridae*: Salamanders.

Tylototriton verrucosus Anders. The Indian Salamander.

Mr. C. M. Inglis, Curator of the Darjeeling Museum, sent some living specimens of this interesting amphibian to the Society for casting. After casting I dissected one specimen to find that it was a gravid female. The date was 11th November 1937. The specimen measured from snout to vent 88 mm. and from vent to tip of tail 94 mm. I made an attempt to keep the remaining specimens alive under observation, but failed completely, they soon died away. The correct food was the main difficulty, I tried insects, snails and some aquatic insects, but nothing seemed to tempt their appetites, they would just lie about on the floats placed in the tank. Out of water they were extremely clumsy, water is their true element.

ORDER: APODA.

FAMILY: *Caeciliidae*.

Ichthyophis glutinosus Fitz. The yellow-striped Blind Worm.

Mr. R. C. Morris sent me a couple of specimens of this curious amphibian in September 1937, from the Billigirirangan Hills, Mysore. On the 8th November, as the specimens died, I dissected one of

them, a female measuring 310 mm. It proved to be gravid and besides 22 large eggs measuring 10 mm. across, it contained 2-4 smaller ova adhering to each of the larger ones. The undissected second one measured 330 mm.

Ichthyophis monochrous Boulenger. The Brown Blind Worm.

In volume xxxi, p. 1039 of the *Journal* I recorded the occurrence of this species from Khandala, Western Ghats. On the 6th September 1931 while collecting frogs, I discovered another specimen living under a stone on the banks of the lake behind a range of hills, locally called the 'Sausages'. I have repeatedly hunted for this animal since its first discovery at Khandala, but without much success. The 1931 specimen measured 232 mm. Though the *Fauna* gives the diameter of the body as half an inch my specimens measured considerably less.

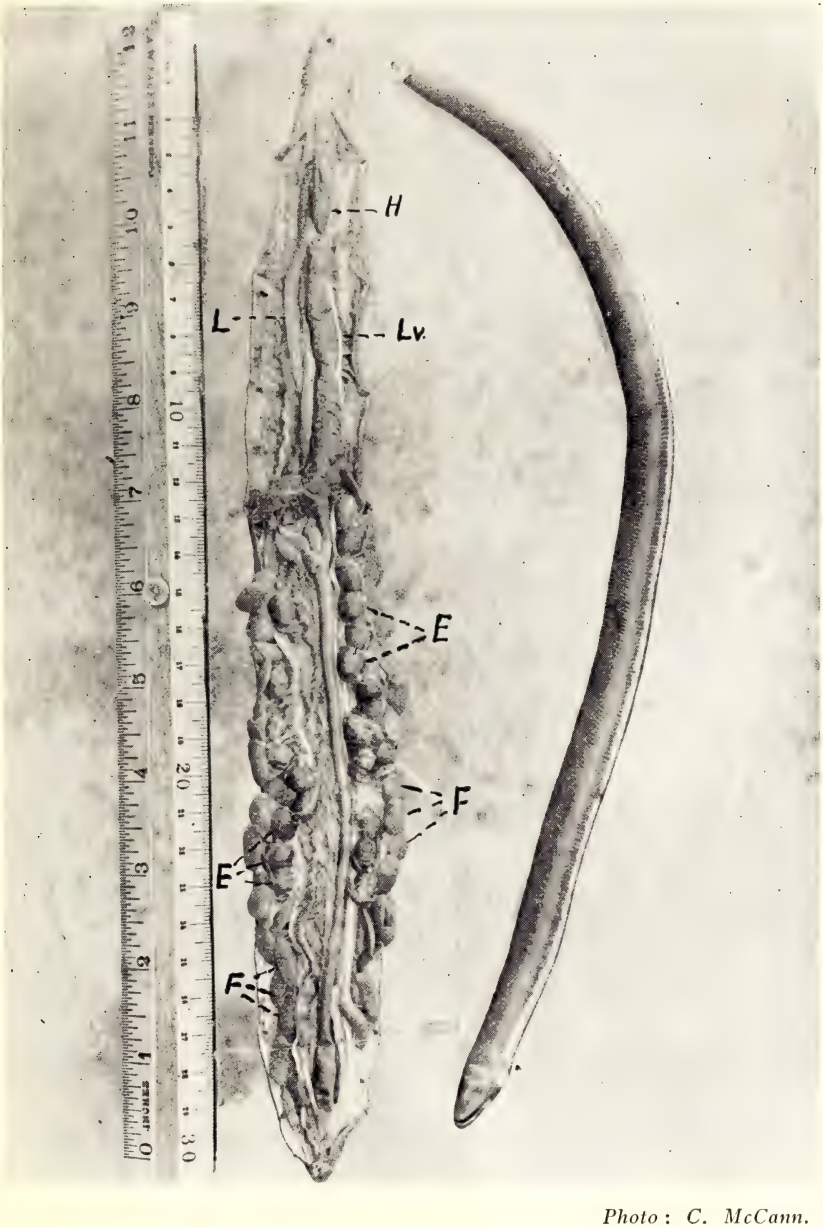

Photo: C. McCann.

The Yellow-striped Blind Worm (*Ichthyophis glutinosus* Fitz).
E. eggs; H. heart; F. fat bodies; L. lung; Lv. liver.

THE ECOLOGY OF A TEMPLE TANK CONTAINING A PERMANENT BLOOM OF *MICROCYSTIS AERUGINOSA* (KUTZ) HENFR.[1]

BY

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(*From the Health Department of the Corporation of Madras*).

There are in the city of Madras some five hundred ponds or tanks, of which about a hundred or so are dry from June to September. The remaining contain water at all seasons of the year, but differ from one another in several important respects. They may, however, on the basis of their aquatic vegetation be broadly classified into three groups: (i) those containing abundant macrophytic vegetation without phyto- and zoo-plankton, (ii) those containing abundant phyto- and zoo-plankton without any macrophytic vegetation, and (iii) those containing both macrophytic vegetation and phyto- and zoo-plankton.

All these tanks or ponds are, in one way or another, sources of serious trouble to the health authorities of the Municipal Corporation. Many of them afford breeding places for the larvae of malarial mosquitoes, and also produce a foul odour during the south-west monsoon season (July to September), when numerous complaints are received every year by the Corporation. Whether these tanks are really inimical to the health of man and animals drinking their waters remains a problem for investigation.

In the case of the first group of ponds remedial measures are easily taken by dredging or removing physically all the aquatic weeds and plants. But the problem is not so simple in the case of the second and third groups. The second group are ponds of 'artificial origin and often of very ancient date', which consist absolutely of one or several species of a blue-green alga, *Microcystis* sp. These algal forms are present at all seasons of the year and in such abundance as to exclude almost all others; they may be said to have formed a permanent water bloom. By their death and decay, they not only affect the taste of the water but also produce a characteristic foul smell, which the health authorities of the Corporation are unable to prevent. These minute algal forms float freely in the water, so that it is not possible to remove them easily and completely unless all the water is pumped out. Such a procedure would be uneconomical. So, ways and means have to be found for the eradication of the algal pest.

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[1] Abstracted from a paper read before the Indian Academy of Sciences at the meeting held in Madras in December 1938.—*Eds.*

Studies of the physical, chemical and biological conditions of the many *Microcystis* ponds in the city, under their natural conditions and during the different seasons of a year, will most probably throw light on the causes responsible for the permanent water bloom and for the production of the foul smell during certain seasons of the year.

These studies, besides being of great significance from the health point of view are also of great scientific interest; for the ecology of lakes or ponds with a permanent water bloom is unknown in the temperate regions. Lakes or ponds with permanent water bloom are known only in the tropics, and the ecology of such waters, as far as the author is aware, has not been studied. In this paper, it is therefore proposed to put on record the changes noticed in the physical and chemical conditions of one of these ponds, during a year.

The pond in Krishnappa Naicken Tank St. attached to Kasi Viswanather Temple has been selected for this purpose as numerous complaints have been received about it, from the residents of the locality. It is used by the people of that division for all religious purposes. It is a rectangular pond measuring 285 ft. by 230 ft., and 10 ft. deep. It is situated in the midst of a thickly populated part of the city, and is surrounded on all sides by rows of houses belonging to middle class people. On all four sides, perpendicular walls rise up to about twenty feet above the surface of the water. They are intended as a protection against falling into the tank, but they also prevent the wind from disturbing the surface water. The tank never runs dry, as the existence of a perennial spring somewhere near the centre is reported to be present. There are no trees in the neighbourhood, so that the rays of the sun fall directly upon the tank between 8 a.m. and 4 p.m. every day.

Samples of water were collected, usually between 8 a.m. and 9 a.m., once a fortnight from one and the same place near the northern *ghat* or entrance into the tank. Bottles and the reagents required for the determination of the dissolved gases and hydrogen-ion concentration were taken in a carriage and the analyses for the same were done on the spot. A Winchester quart full of water was taken to the laboratory for the other chemical tests. The investigation was begun on the 22nd February 1934 and continued upto the 30th January 1935.

Physical Conditions.

(*a*) *Colour*:—The water was greenish throughout the year on account of the thick growth of *Microcystis aeruginosa*.

(*b*) *Transparency*: This was measured by means of an aluminium Secchi's disc of 20 cm. diameter. The figures varied from a minimum of 8 cm. in August and September to a maximum of 33 cm. in October.

The records show that (i) the water was least transparent during the south-west monsoon and most transparent during the hot weather period; (ii) the figures increased from February to May; decreased thereafter till the minimum was reached in September; increased again from October to December; and finally began to decrease in January.

(*c*) *Temperature*:—The temperature of the surface water was measured by means of an accurate thermometer graduated from 0.0 to 50°C., each degree being sub-divided into a fifth of a degree. It was found to vary between a minimum of 25°.1 in December and a maximum of 30°.8 in May.

The records show that (i) the temperature of the water was highest during the hot weather and least during the north-east monsoon; (ii) it increased from February to May when the maximum was reached, and later on decreased till September; increased again in October, only to decrease gradually till December when the minimum was reached. Finally from December to January, it increased again.

Thus the temperature of the surface water in the tank follows closely the changes in the temperature of the atmosphere.

CHEMICAL CONDITIONS.

(*d*) *Dissolved oxygen*:—The dissolved oxygen content of the surface water was estimated according to Rideal and Stewart's modification of the Winkler method. It was found to vary between a minimum of 0.0 cc. in September and October and a maximum of 8.49 cc. in July.

The results show that (i) the content of dissolved oxygen was greatest during the hot weather period and least during the latter half of the south-west monsoon season; (ii) it was found to increase generally from February to May, and to decrease thereafter till September or October, and again to increase from October to January.

The surface water was found supersaturated with dissolved oxygen on 8-3-34, 14-7-34, and 23-11-34; it was in maximum (151.5%) on 14-7-34 and in minimum (103.4%) on 23-11-34. There was practically no oxygen present in the water in September, October and December; and during the remaining months, it was found to fluctuate between 23.9% and 84.3%.

The oxygen content in any piece of water is dependent upon such factors as (i) solubility of oxygen, depending upon the temperature at the time of sample collection; (ii) intensity of illumination; (iii) photosynthetic process; (iv) respiratory process; (v) wind action; and (vi) abundance of vegetation. The amount of oxygen at any time of the year therefore will be the resultant of the several factors mentioned above.

(i) Taking the first factor into consideration, it will be seen from a few of our findings that the content of dissolved oxygen in the tank does not depend upon the physical factor of solubility. For according to the law of solubility of gases, periods of high temperature should be periods of low oxygen content and *vice versa*; but that it is not so in this case, is evident from the following: (*a*) from February to 8th March there was no change in temperature (29°.4c), but the oxygen content increased from 3.72 cc. /1 to 6.6 cc. /1; (*b*) from April to May, when the temperature increased from 29°.5 to 30°.6, the dissolved oxygen also increased from 1.34 cc./1 to 4.12 cc./1; (*c*) from May to June, the temperature decreased from 30°.8 to 29°.8, and the dissolved oxygen also decreased from 4.12 cc./1 to 2.87 cc./1; from June to July, the temperature decreased from 29°.8 to 29°.6, while the dissolved oxygen increased from 2.87 cc./1 to 8.49 cc./1; from July to August there was a fall in temperature from 29°.2 to 28°.2, and the oxygen content also decreased from 8.49 cc./1 to 1.75 cc./1; and finally from August to September there was an increase from 28°.1 to 29°.1, while the oxygen decreased from 1.7 to zero. So, it will be apparent from the above that the controlling factor was not the temperature of the water.

(ii) The oxygen content of the tank, though the water be taken nearly at the same time of the day, varies greatly; and this variation appears to depend largely upon the intensity of illumination as measured by the hours of bright sunshine. Generally, the oxygen content was comparatively high in February, March, April, May, June, July, November, and January when the sky was clear and cloudless. The oxygen content decreased considerably from August to October, when the sky was cloudy with frequent rainfall. During the period when the sky was bright and clear, the algal vegetation of the pond carried on active photosynthesis and thus increased the oxygen content of the water. Thus the tank water was supersaturated on three occasions: 8-3-34, 14-7-34, and 23-11-34. The maximum amount of supersaturation of 151.5% was recorded on 14-7-34, and this can be explained only as being due to the photosynthetic activities of the dominant alga, *Microcystis aeruginosa* which was found in abundance. On those dates when there was no bright sunshine, and at night, the algal and animal forms consume the oxygen present in the water. During August to October, there was practically no

oxygen in the water, and its absence might be due to the absence of bright sunshine and to the presence of plenty of dead algal slime floating near the place of sample collection. In November, the cloudy weather cleared up temporarily and the alga was able to resume its photosynthetic activities with the result that the amount of oxygen increased considerably. Again in December there was a great fall in the content of oxygen due to lack of bright sunshine when the respiratory activities were greater than the photosynthetic activities. So, the amount of oxygen in a pond of this type depends largely upon the intensity of illumination, and the consequent photosynthetic processes, and also upon respiratory activities of the animal and vegetable life, and organic matter.

(iii) Another important source of oxygen is the atmosphere, and it is of particular importance in large and shallow lakes which are exposed to the action of the winds. Waves are formed and thereby different layers of water are exposed to the air, so that the water is oxygenated by mechanical admixture of air and water particles. Such a condition does not exist in the case of this tank, for its sides are steep and it is protected on all sides by high walls and rows of houses. So there is no possibility for the formation of big waves which alone can expose different layers of water for oxygenation to the atmosphere.

(iv) During photosynthesis, carbonic acid is split up by the aquatic vegetation in a piece of water whereby assimilation of carbon takes place and also liberation of oxygen to the surrounding water. The greater the abundance of vegetation, the greater the assimilation and consequently the greater the liberation of oxygen. So, in our tank which contains abundant algal vegetation, the quantity of oxygen also must be great. The tank water being supersaturated to the extent of 151% can be due only to the presence of abundant algal growth.

(*e*) *Free carbon dioxide* :—This was not detected at any time during the period of investigation. Its absence can be explained in two ways: either free CO_2 was utilised during photosynthesis by the profuse algal growth as soon as it was formed or the carbonates were found in great quantities so that the free carbon dioxide formed during respiration and oxidation of organic matter was not sufficient to convert all of them into bicarbonates. The exact cause for its absence can be ascertained only after a further detailed study of its diurnal variations during the different seasons of the year.

(*f*) *Hydrogen-ion concentration* (pH) :—The hydrogen-ion concentration of the surface water expressed in terms of pH was found to vary from a minimum of 8.8 in January to a maximum of 9.7 in May. It was determined with a Hellige comparator, using thymol blue as an indicator.

The records show that (i) the pH values were highest during the hot weather period and south-west monsoon, and lowest during the north-east monsoon; (ii) they were nearly constant or increased by a narrow margin of 0.1 or 0.2 units from February to September, and decreased gradually to the minimum thereafter in January.

The hydrogen-ion concentration expressed in terms of pH depends upon the amount of carbonates of calcium and magnesium and the carbon dioxide tension in the water. The latter in its turn is influenced by the photosynthetic activities of the aquatic vegetation and the animal life present. In the case of this tank, animal life is poor (fish is totally absent) but the algal vegetation is extraordinarily great, so that the chief factor responsible in controlling the pH is the alga. The pH values during the year under investigation may be divided into five periods :—from February to May, when the pH rose up from 9.3 to 9.7; from May to June, when it decreased slightly from 9.7 to 9.5; from June to September, when there was no change (9.6); from September to October, when it decreased from 9.6 to 9.1; and from October to January 1935, when it decreased further from 9.1 to 8.8. The tank water was therefore extremely alkaline throughout the period of investigation.

(i) It is well known that during photosynthesis the carbonates of calcium and magnesium are precipitated from their respective bicarbonates due to rapid carbon assimilation from the dissolved bicarbonates, and the water becomes more alkaline. So, if in a piece of water the pH values exceed 8.1, then it may be inferred that the photosynthetic activities are greater than the respiratory processes, for a 'saturated calcium bicarbonate solution in

equilibrium with air containing about 3 parts per 100,000 of carbon dioxide is close to pH 8.1' (Atkins and Harris 1924). In the case of our tank, the water became more and more alkaline (pH 9.3 to 9.7) from February to May when the temperature and hours of bright sunshine were higher. A value of pH = 9.0 is usually recorded for a saturated solution of pure calcite (Atkins and Harris). And pH values higher than 9.0 have to be attributed to the presence of magnesium salts, for the pH value of a saturated solution of magnesium carbonate is close to pH = 10' (Atkins and Harris). Therefore the period during which the pH values reached 9.7, may be construed as being due to intense photosynthesis and to the resulting precipitation of magnesium salts.

The high pH values of the tank water (8.8 to 9.7) which are far above 8.1 would seem to show therefore that the photosynthetic activities are generally great; and that the period from February to September is one of intense photosynthesis, while that from October to January is one of mild photosynthesis.

(ii) It was suggested from the high pH values that the photosynthetic activities must be very high at all times in the tank, so that one would expect the water to be always saturated or supersaturated. Atkins and Harris have taken 8.1, or any value above, to be a sure indication of supersaturation. The water of our Madras tank ought then to have been supersaturated with oxygen. Nevertheless this was not the case. Except on three occasions, the water was generally undersaturated or did not contain any dissolved oxygen. The presence of considerable quantities of organic matter may perhaps be responsible for this strange behaviour.

(*g*) *Total and fixed solids* :—The figures for the total solids varied from a minimum of 126.0 parts per 100,000 in December to a maximum of 180.4 parts in September; and the fixed solids varied from a minimum of 104.6 parts in February to a maximum of 139.2 parts in August.

The records show that (i) the figures for total solids were highest during the south-west monsoon and least during the north-east monsoon; and (ii) they increased gradually from February to September when the maximum was recorded, and decreased thereafter till the minimum was reached in December.

The fixed solids increased from February to August, when the maximum was reached and decreased thereafter till December, and increased again in January. Therefore, the fixed solids were highest during the south-west monsoon season and lowest during the cold weather period instead of during the north-east monsoon.

Atkins and Harris have found the electrical conductivity (a measure of the dissolved solids) to vary inversely with the pH changes noticed in the ponds studied by them. The explanation for this relationship has to be sought in the gradual decrease in the quantity of bicarbonates dissolved in a water resulting from the carbon assimilation and the consequent precipitation of the less soluble carbonates of calcium and magnesium. In the case of our pond, measurements of the electrical conductivity of the water were not made, but only of the total and fixed solids present in the original water. These were found to increase with the increase in pH. The total solids represent not only the suspended matter but also the dissolved matter. It is therefore quite likely that the presence of the abundant suspended matter has masked the true relationship. A measure of the total dissolved solids alone would probably have portrayed a true picture, but unfortunately that was not done.

(*h*) *Hydrocarbonates and Bicarbonates* :—The hydrocarbonates were found to vary from a minimum of 3.8 mg. per 100 cc. in December to a maximum of 21.2 mg. The bicarbonates were found to vary from a minimum of 6.1 mg. in May to a maximum of 31.4 mg. in January.

The records show that (i) the hydrocarbonate ions were found to be highest during the hot weather and south-west monsoon, and least during the north-east monsoon and cold weather periods; and (ii) they increased gradually from February to July when the maximum was reached, and decreased thereafter to the minimum in December, and increased again finally from December, to January.

The curve for bicarbonates runs almost opposite to the hydrocarbonates curve. The findings are that (i) the bicarbonates were least during the hot weather and south-west monsoon, and highest during the north-east monsoon and cold weather periods; and (ii) they decreased gradually from February to May when the minimum was reached; increased from May to July; decreased

again from July to September and increased thereafter till the maximum was reached in January.

Generally, in the absence of 'free carbon dioxide' the bicarbonates are decomposed by algal vegetation which abstract the carbonic acid from them, precipitating the less soluble carbonates of calcium and magnesium. In this tank water, the bicarbonates appear to constitute the chief source of carbonic acid for the alga *Microcystis aeruginosa.* A study of the figures recorded shows that the whole period of investigation can be roughly divided as below: from February to May when the general trend of the bicarbonates was to decrease gradually (except on 27-4-34 when there was a spurt) and the carbonates to increase; from May to June there was a big increase in bicarbonates and a decrease in carbonates; from June to 8th August there was a decrease in bicarbonates and an increase in carbonates; from 8th August to 25th October there was a gradual increase in bicarbonates and a decrease in carbonates; from October to November there was a slight decrease in carbonates and bicarbonates; from November to December there was a slight increase in bicarbonates and a decrease in carbonates and finally from December to January there was an increase in both carbonates and bicarbonates. Normally the decrease or increase of bicarbonates may be respectively ascribed to the photosynthetic or respiratory process of the alga in the pond. There were however, a few occasions when both the carbonates and bicarbonates decreased or increased and the reasons for this behaviour are not known.

(i) During the periods February to May, June to 8th August, and October to November the atmospheric conditions were conducive to intense photosynthesis, so that the carbon dioxide from bicarbonates was utilised for assimilatory purposes by the alga, resulting in the increased precipitation of the less soluble carbonates. Under these circumstances one would have expected a progressively increasing amount of dissolved oxygen in the water tending towards supersaturation. But that was not always the case. Excepting 8th March, 14th July, and 23rd November, on all other dates the water was very much undersaturated. This indicated therefore that there was some other factor operating against an increase in the oxygen content of the water. This will be discussed later under 'organic matter'.

During the other periods (from 8th August to 25th October and from November to December) when the bicarbonates increased and carbonates decreased, there was very little or no oxygen in the water. This condition was most probably due to the prevailing weather conditions, which prevented the photosynthetic activities of the alga, but increased its respiratory activities, so that free carbonic acid was added to the water instead of oxygen. It may have been due also to its absorption by dissolved organic matter resulting in the liberation of carbon dioxide and also available nitrogen (Pearsall 1923).

In spite of the interfering factor an intimate relation between the hydrogen-ion concentration and the several factors mentioned above has been noticed on some occasions in this tank. On 8th March and 14th July there was an increase in oxygen content, a fall in bicarbonates, and an increase in carbonates and pH, over the corresponding figures of 22nd February and 21st June, respectively. Again, on 25th October, there was a decrease in oxygen content, an increase in the amount of bicarbonates, a decrease in carbonates and in pH, over the corresponding figures for 22nd August.

(*i*) *Phosphates* :—Phosphates were present in small quantities and were found to vary from a minimum of 0.012 mg. in May to a maximum of 0.040 mg. in August. They were in minimum during the hot weather period and in maximum during the south-west and the north-east monsoon; and (ii) they were found to decrease gradually from January to June and to increase thereafter till they were present in maximum on 22nd August. From August to January they were found to be nearly constant generally.

Phosphates are among the important nutrient substances found in lakes or ponds. They are utilised by algae during the process of photosynthesis, so that they are usually reported to be absent or present in very small quantities during summer months and to be present in large amounts during winter months. In the pond under investigation, however, they were found in fairly large quantities throughout the year. Even during the period of intense photosynthesis they were not entirely absorbed by the profuse growth of *Microcystis aeruginosa.* The sources of phosphates may be either due to constant and daily contamination of the tank water by human agencies, or

to the diurnal chemical stratification by day and circulation at night, so that phosphates are brought to the upper region of photosynthesis from below, where they are regenerated from the dead algal cells by bacterial action.

(*j*) *Silicates* :—The quantity of silicates varied from a minimum of 2.0 mg. in November, December and January to a maximum of 3.604 mg. in May.

The quantity of silicates was high during the hot weather and south-west monsoon, and low during the north-east monsoon ; and (ii) it fluctuated between very narrow limits (3.0-3.6 mg.) between February and September, decreased thereafter, and reached a minimum in November, December and January.

Though found in fairly large quantities in the tank water, the silicates do not seem to have any biological significance in view of the absence of diatoms.

(*k*) *Chlorides* :—These were found to vary from a minimum of 40.2 parts in November to a maximum of 63.0 parts in July. They were very high during the south-west and low during the north-east monsoon ; and (ii) they increased gradually from February to July when the maximum for the year was reached, and decreased later till November when the minimum was reached. From November onwards they increased again.

The content of chlorides was very high in the tank and, therefore, showed that it was highly polluted.

(*l*) *Hardness* :—The total hardness varied from a minimum of 4.0 parts in April and May to a maximum of 8.0 parts in February, June, August, September, October, December, and January. It was least during the hot weather period and highest during the rest of the year ; it decreased from February to May, increased thereafter generally and varied between narrow limits from June to January.

Although no relationship was evident between pH and total solids, a distinct relationship could be traced between the pH and the total hardness of the water. The pH increased from February to May from 9.2 to 9.7, while the total hardness showed a general decline from 8 to 4 parts per 100,000. The decrease in hardness has to be attributed to the precipitation of the less soluble carbonates of calcium and magnesium owing to the equilibrium being upset by the algal assimilation of carbon from the bicarbonates dissolved in the tank water.

(*m*) *Organic substances and their decomposition products* :

(i) *Ignitible matter* : This was found to vary from a minimum of 15.6 parts per 100,000 in December to a maximum of 48.0 parts in August. The records show that (i) the content of ignitible matter was lowest during the hot weather period and highest during the south-west monsoon ; and (ii) it was found to decrease from February to 27th April, and thereafter to increase till the maximum was reached on 22nd August, when it gradually decreased till December, reached a minimum, and again increased from December to January.

(ii) *Oxidisable organic matter* (*Tidy's* 4 *hours' Test*) :—This was found to vary from a minimum of 1.431 parts in February to a maximum of 2.327 parts in July. The content was least during the cold weather and hot weather periods and highest during the south-west monsoon ; it was found to decrease gradually from February to 27th April and to increase later on till July when the maximum was reached; from July onwards it decreased till a second minimum was reached in November, when it again increased till January.

(iii) *Ammoniacal Nitrogen* : This was found to vary from a minimum of 0.003 in March to a maximum of 0.216 part in October. The content was lowest during the hot weather period and highest during the south-west monsoon ; it was found to decrease from February to May (when the minimum was reached) and to increase thereafter till October when the maximum was recorded ; it decreased again from October to January.

(iv) *Albuminoid Nitrogen* : This was found to vary from a minimum of 0.120 in August to a maximum of 0.280 in September. It was lowest during the hot weather and the first half of the south-west monsoon and highest during the latter half of the south-west monsoon and the north-east monsoon ; it was found to increase gradually from March to June when the first maximum was reached ; it thereafter decreased till 8th August, and increased till December when the second maximum was reached ; from December decreased again.

(v) *Nitrites and nitrates* : Except for one occasion in October when they were present in traces, they never were detected,

(*a*) The relationship that exists in a piece of water between the oxidisable organic matter and dissolved oxygen has been admirably portrayed by Knauthe (1898), Kolkwitz (1914), and Pearsall (1923). Similar observations have been made in this tank. Briefly stated, they are: (1) during bright sunny days, oxygen is liberated in such abundance that the water becomes supersaturated; (2) during nights and on dark cloudy days (which are few and far between) the tank water is depleted of its oxygen content; (3) depletion of oxygen is also caused by the oxidation of organic matter dissolved in the water; (4) the second and third processes result in the liberation of carbon dioxide, thereby increasing the content of bicarbonates, and in the formation of free ammonia and other nitrogenous substances: and (5) thus extreme variations in the dissolved oxygen content result.

(*b*) Normally, waters containing a large number of *Myxophyceae* are distinguished by a high content of organic matter and nitrogenous substances (Pearsall 1923). Although the tank is populated almost entirely by a form of *Microcystis* and contains also high organic content, nitrogenous substances like nitrites and nitrates are absent. Their absence may be explained in two ways. They are probably utilised during photosynthesis as soon as they are formed daily, leaving practically nothing behind, or they are acted upon by the denitrifying bacteria which are very active at higher temperatures (Pia 1934). But Atkins (1932-33) believes that this second reason is not so satisfactory as the first, in view of the fact that denitrifying bacteria do not act in the presence of an abundant supply of oxygen in the surface waters of the tropical seas. According to him their absence in tropical seas is due to their rapid utilisation by algae in the well-lighted upper layers of water during long and intense photosynthesis. In any case, their absence from this tank water is not the only one on record. Hutchinson *et al.* (1932) have reported mere traces or total absence in all the ponds and lakes of South Africa, and Beadle (1932-34) has found the same to be the case with the Rift Valley lakes of East Africa. Kolkwitz (1914) has recorded their absence in Lietensee under conditions almost identical with those found in our tank water. Harold (1934) has stated that a marked reduction in nitrites and nitrates is usually observed in cases of abnormal algal development. In their absence, therefore, free ammonia seems to have been utilised by the alga in the pond, as will be evident from its low figure from February to May. On other dates, the free ammonia is considerably higher, especially when the content of dissolved oxygen is low, indicating the oxidation of the organic matter present in the water.

(*c*) As for albuminoid nitrogen—this was found in large quantities, and proved indirectly the presence of abnormal quantities of algal development in the tank water (Harold 1934). According to Drew (1914) the presence of a large quantity indicates the corresponding presence of a large amount of organic matter in solution; and a gradual rise from February to September indicated that a greater amount of decomposition was going on in the water; and the time when it was in maximum was when the bacteria were decomposing the organic matter into soluble substances.

Seasonal Variations.

Summarising briefly the changes which occurred in the physical and chemical conditions of the pond during the four seasons of 1934, the following observations may be made.

(*a*) *The cold weather period* (*January* 1935, *and February* 1934).

This period was characterised by a large number of hours of bright sunshine, small percentage of cloudy days, low wind velocity, low temperature, and very little rainfall.

The tank water was greenish with plenty of leaves, flowers, and other vegetable debris, floating upon the surface. A thick green scum was seen moving slowly on the surface near the middle of the pond. The transparency of the water was rather moderately low, so that the rays of the sun could penetrate to a depth of 21-27.5 cm. below the surface. The total and fixed solids were moderately low, and the nutrient substances like phosphates, silicates, ignitible and oxidisable organic matter, ammoniacal nitrogen, albuminoid nitrogen were also moderately low. Nitrites and nitrates were absent. The temperature

of the water was low and its dissolved oxygen content was fairly great, carbonates low, bicarbonates high, pH low, the total hardness and chlorides moderately low.

The heleoplankton was composed almost exclusively of *Microcystis aeruginosa*, in abundance throughout the period.

(*b*) *The hot weather period* (*March to May*).

A conspicuous feature of this period was its high temperature with practically no rainfall, maximum hours of bright sunshine, low percentage of cloudy days, and moderate wind velocity.

The tank water was generally coloured greenish, with a large area of thick green scum floating near the corner adjoining the place of sample collection. The depth of visibility as measured by means of a Secchi's disc was slightly more than during the previous period. The total and fixed solids, silicates, and chlorides, were higher while the phosphates, ammoniacal nitrogen, albuminoid nitrogen, oxidisable and ignitible organic matter were lower than during the previous period. Nitrites and nitrates continued to be absent. The dissolved oxygen content was uniformly high, the water occasionally being even supersaturated in spite of the higher temperature of the water.

The heleoplankton was quantitatively well developed with abundant water-bloom of an almost pure growth of *Microcystis aeruginosa*.

(*c*) *The south-west monsoon season* (*June to September*).

The outstanding features of this period were very small hours of bright sunshine, high percentage of cloudy days, moderately high temperature, lowest velocity of wind, and a moderate amount of rainfall.

The colour of the water continued to be greenish due to the large quantities of dead and living *Microcystis aeruginosa* present in suspension. The water surface was covered in several places with a thick coagulated green mass of *M. aeruginosa* which was being driven slowly by a slight breeze. The depth of visibility was minimum.

As for the chemical characteristics of the water, it was found to contain the maximum amount of total and fixed solids, phosphates, silicates, chlorides, oxidisable and ignitible organic matter. Ammoniacal nitrogen was high while albuminoid nitrogen was low. Nitrites and nitrates were absent.

The oxygen content was high during the first half of the period, when the carbonates were high, bicarbonates low, and pH high. The oxygen content was least (practically nil) during the second half of the above period, with low carbonates, high bicarbonates, and high pH.

The heleoplankton consisted almost wholly of *Microcystis aeruginosa* in abundance, but in a poor condition.

(*d*) *The north-east monsoon season* (*October to December*).

This period was notably wet with maximum amount of rainfall, smaller hours of bright sunshine, greater percentage of cloudy days, lower temperature, and higher velocity of wind.

The tank water continued to be greenish; it was covered with a floating green scum in all the corners and gradually spreading to the middle with the blowing of a gentle wind. The algal scum was not so dense as in the previous season.

The chemical conditions of the tank water had profoundly changed during this period. The total and fixed solids, chlorides, phosphates, silicates, oxidisable and ignitible matter were lower than during the previous season. Nitrites and nitrates were either present in traces or were absent. The content of dissolved oxygen varied, being greater or less, carbonates lower, bicarbonates higher, pH lower, and the total hardness higher.

The character of the heleoplankton was unchanged, containing an abundant growth of *Microcystis aeruginosa*.

Factors influencing the development of a permanent bloom of *Microcystis aeruginosa* in Krishnappa Naicken Tank water.

The phenomenon known as 'water bloom' is usually brought about in lakes and ponds by the rapid multiplication of some member of the *Myxophyceae*, *Chlorophyceae*, *Heterokontae*, or *Bacillariophyceae* on calm bright days, when the organism can concentrate in the upper layers of the water. Generally,

this phenomenon occurs in temperate regions for a few days only in August, and is caused by a member of the *Myxophyceae,* notably *Microcystis aeruginosa.* In the tropics, on the other hand, the *Myxophyceae* are known not only to dominate the algal flora of lakes and ponds, but also to dominate the entire plankton of a considerable number of ponds [Fritsch 1907, Geitler and Ruttner 1936]. In the pond under investigation, *Microcystis aeruginosa* is found in abundance at all seasons of the year almost to the exclusion of other forms of the same group.

For a mass production of an alga to take place in any piece of water at all seasons, optimum conditions for its development must obtain. These are light, heat, and nutrient substances; and they are found in plenty in the water of Krishnappa Naicken Tank.

The chief physical factors contributing to the prolific growth of the alga in a tank are temperature, intensity of illumination, absence of movement of water by wind action, colour, and transparency, and no inlet or outlet. (Fritsch 1907). In the tank under investigation the temperature of the surface water undergoes seasonal and diurnal variations from 25° to 32°C.; usually it is very low early in the morning, but as the day advances, the full heat of the sun is received from 8 a.m. to 4 p.m. during which time the intensity of illumination varies ordinarily from a minimum of 5 to a maximum of 10 hours every day; the maximum temperature of the water is attained in the afternoon.

The diurnal increase in temperature is confined only to the upper surface layers of the water on account of the colour and transparency of the water. The colour of the water is greenish almost throughout the year, and the algal masses floating upon the surface of the water are so dense that a Secchi's disc becomes invisible within about 30 cm. from the surface. This means therefore that the depth to which the sun's rays can penetrate is very small, so that the zone of photosynthesis is extremely small compared with the zone of reduction extending towards the bottom.

If the sun's rays cannot penetrate into the lower layers of the water on account of its low transparency, then the temperatures of the lower layers also will be considerably less than those of the upper layers, and thermal stratification must result. The formation of a thermal stratification is also helped by the highly steep and perpendicular walls rising on all sides of the tank. The walls prevent strong winds from blowing over the surface of the water and forming big waves. In lakes and ponds which are exposed to the action of wind, big waves are formed which prevent the formation of a permanent thermal stratification (Worthington and Beadle 1932, Ruttner 1931). In this pond where there is no such possibility a permanent thermal stratification is possible. The tank water remains undisturbed excepting for occasional bathers disporting in a limited area near any of the three entrances to the tank. The conditions are therefore ideal for an intense photosynthesis whereby rapid reproduction of the alga takes place in the upper well-illuminated layers of the water at all times of the year.

That the thermal stratification is only temporary and of daily formation may be gathered from the facts observed by the author and the reports of persons who take their bath in the tank. People who bathe early in the morning or late at night feel the temperature of water to be homogeneous, while in the afternoon bathers distinctly appreciate the difference between a warm upper and a cold lower layer. These observations go to show that the thermal stratification formed in the tank is only temporary; a view further supported by the studies in the diurnal variations in temperature and dissolved gases of a similar, but smaller, pond in the Madras Horticultural Garden (Unpublished thesis of Miss Mercia Janet), and by the absence of fish life in the tank. Further, the duration of day and night being nearly equal 'the diurnal period of radiation is substantially equal to that of insolation', so that considerable heat cannot be stored up in the upper layers (Juday 1915-1916).

The temporary thermal stratification appears to be accompanied by temporary chemical stratification in oxygen, bicarbonates, carbonates, hydrogen-ion concentration, phosphates, silicates, ammoniacal nitrogen, albuminoid nitrogen, and oxidisable organic matter. This is also an inference, which has to be verified by further work. This inference is drawn from the low figures for transparency. As has been already stated, the limit of photosynthesis is confined to the top

few centimetres of water. Consequently in the deeper bottom portion of the tank, bacterial action must be at work in decomposing the dead algal matter which has settled there. As a result of reduction processes, there will be a lowering of the oxygen content, and an increase in bicarbonates, phosphates, ammoniacal and albuminoid nitrogen, and oxidisable organic matter. All these nutrient substances are formed in the lower layers and used up in the upper layers into which sun's rays easily penetrate; they are brought to the surface at night when the different layers of water attain the same temperature. The processes of consumption and regeneration of nutrient substances are daily taking place so that there is no dearth of foodstuffs for the alga at any time. It is therefore able to multiply in enormous numbers.

Among the chemical factors which are essential for plant growth may be mentioned phosphates, nitrogenous substances, and salts of calcium and magnesium. Phosphates are always present in the water in considerable quantities, so that they do not seem to constitute a limiting factor, but permit of continued growth. Their occurrence in fairly large amounts is an additional proof for the existence of a temporary thermal and chemical stratification. If that were not the case, the phosphates would have been consumed in no time during the intense photosynthetic processes going on daily undisturbed in the tank water, and this would have resulted in shortage or complete exhaustion at a certain period of the year. But the fact that they are available in fairly large quantities and at all seasons of the year can be explained only by our inference of daily formation of thermal stratification by day and of its destruction by night. Phosphates result most probably from the decomposition of the abundant algal cells which sink continuously to the bottom, where they are decomposed by bacterial agencies. A study of the diurnal variations in the vertical direction of the tank water will be most interesting and may afford an insight into the exact mechanism of their formation at all seasons of the year in the tank water.

As for nitrogenous substances, the absence of nitrites and nitrates may appear to be an extraordinary feature in a water of this type, which contains abundant algal vegetation and is subjected also to heavy contamination. But excepting one occasion when they were found in traces, their presence was never detected. In their absence the alga seems to utilise the ammoniacal nitrogen present in the water, and this fact is easily seen from the very low figures during the hot weather period compared with those for the rest of the year.

Besides phosphates and nitrogenous substances, the tank water contains also at all seasons of the year fairly large quantities of the salts of calcium and magnesium, and organic matter. Therefore the chief factors such as high temperature, long hours of bright sunshine, large quantities of phosphates, free ammonia, oxidisable organic matter, and salts of calcium and magnesium are always available and they are known to be quite favourable for the luxuriant growth of *Myxophyceae* (Pearsall 1923, Thienemann 1925, Fritsch 1907).

Another important factor 'aiding' the development of this alga to the exclusion of other generic forms is 'the presence of a second colouring matter (phycocyanin) side by side with the chlorophyll'. The presence of this additional pigment acts as a screen and also 'plays some other important part in adapting the blue-green group to varying types of illumination' (Fritsch 1907).

Summing up, the conditions of life favouring the development of a permanent bloom of *Microcystis aeruginosa* in the tank water, are high temperature, intensity of illumination, stagnation, large amounts of phosphates, ammoniacal nitrogen, albuminoid nitrogen, organic matter, salts of calcium and magnesium. Gaseous solutes do not seem to have any influence. But it is not known exactly why the tank water should favour the exclusive development of *Microcystis*. This requires further detailed study of all other Microcystis ponds in the city, and further work is in progress.

Krishnappa Naicken Tank and Lietensee compared.

It is now proposed to make a brief comparison between the physical and chemical conditions of our tank water with those of Lietensee in Germany where the phenomenon of water bloom has been reported to occur with great regularity every year during the warm summer months from 1908 to 1914 (Kolkwitz). During this period—April to September—a mass production of

the blue-green alga, *Oscillatoria Agardhii* Gom. has occurred to the exclusion of almost all other forms of algae.

Lietensee resembles our tank in being shallow and having no outlet or inlet. It is 810 metres long, 75 metres broad, and 2 metres deep. It is surrounded on all sides by sloping walls of brick and mortar, which rise high above the surface of the water. These walls protect its water against strong winds, and thus tend to maintain an approximate tranquillity.

The water is greenish, and has a very low transparency due to the abundant algal growths which prevent the sun's rays from reaching the bottom. The temperature of the surface water consequently becomes higher, but it appears to be only slightly higher than at the bottom. A thermal stratification also seems to develop in it; but it is not known whether it is daily forming by day and breaking at night or is permanent during the period of summer stagnation.

Chemically it resembles our tank water almost in all respects. The oxygen content of the surface water is very high due to vigorous carbon assimilation, and the latter is accompanied by a reduction of bicarbonates; free carbon dioxide, nitrites and nitrates are absent. Free ammonia is either absent or very low, while organic nitrogen and oxidisable organic matter are considerably high. Phosphates and silicates are also present.

In short, the Lietensee at the time of summer resembles our tank in its high surface temperature and low transparency; in the absence of water movement; in its high oxygen content, and low bicarbonate content; in the absence of free carbon dioxide, nitrites and nitrates; in the absence of or a low free ammonia; in the abundance of organic nitrogen, oxidisable organic matter, and chlorides; and in the luxuriant growth of a blue-green alga.

Summary.

1. Very little is known about the ecological conditions of ponds containing a permanent bloom of *Microcystis aeruginosa*, and the conditions of existence for a year in one such pond at Madras is described.

2. The most important factors favouring its development seem to be the high temperature of the water, absence of water movement, high organic content, and phosphates. Nitrites and nitrates are absent. Gaseous solutes do not appear to exert any influence.

3. It is suggested that a diurnal temporary thermal stratification takes place in the pond, and it is destroyed at night. The nutrient substances required for the growth of the alga are brought up daily to the surface from the bottom, where the dead algal cells are decomposed by bacterial action.

4. The tank may be designated as an extreme eutrophic type of water, usually associated with the tropics.

Acknowledgment.

In conclusion the author wishes to take this opportunity of expressing his gratitude to Dr. P. Sadasivan and Rao Bahadur Dr. C. S. Govinda Pillay for their interest in this investigation and for permitting him to publish this paper; and also to Prof. Dr. M. O. P. Iyengar for help in the identification of the plankton algae.

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THE GAME FISHES OF INDIA.[1]

BY

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(*With one colour plate and four text-figures*).

(*Continued from page 794 of Vol. xli, No. 4*).

XI.—THE MAHSEERS OR THE LARGE-SCALED BARBELS OF INDIA.

4. THE BOKAR OF THE ASSAMESE AND KATLI OF THE NEPALESE, *Barbus (Lissochilus) hexagonolepis* McClelland.

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INTRODUCTION.

After Hamilton (**3**, pp. 303-307)[2], McClelland (**10**, pp. 333-338) in his account of the Indian Cyprinidæ dealt with the large-scaled barbels of India and described 5 species, *viz., B. hexastichus, B. progeneius, B. macrocephalus, B. hexagonolepis*, and *B. megalepis*. The first four were described from Assam, while the last species was obtained in the river Kosi. As McClelland's descriptions are brief and inadequate, and his illustrations inaccurate, an attempt was made in an earlier paper (**7**, pp. 324-331) to define the specific limits of his species, but in the absence of authentic material from Assam, the conclusions reached could only be tentative. With a view to study good series of specimens from Assam, a short visit was paid to the Darrang District in November 1939, and the fish fauna of the Brahmaputra and some of its tributary streams

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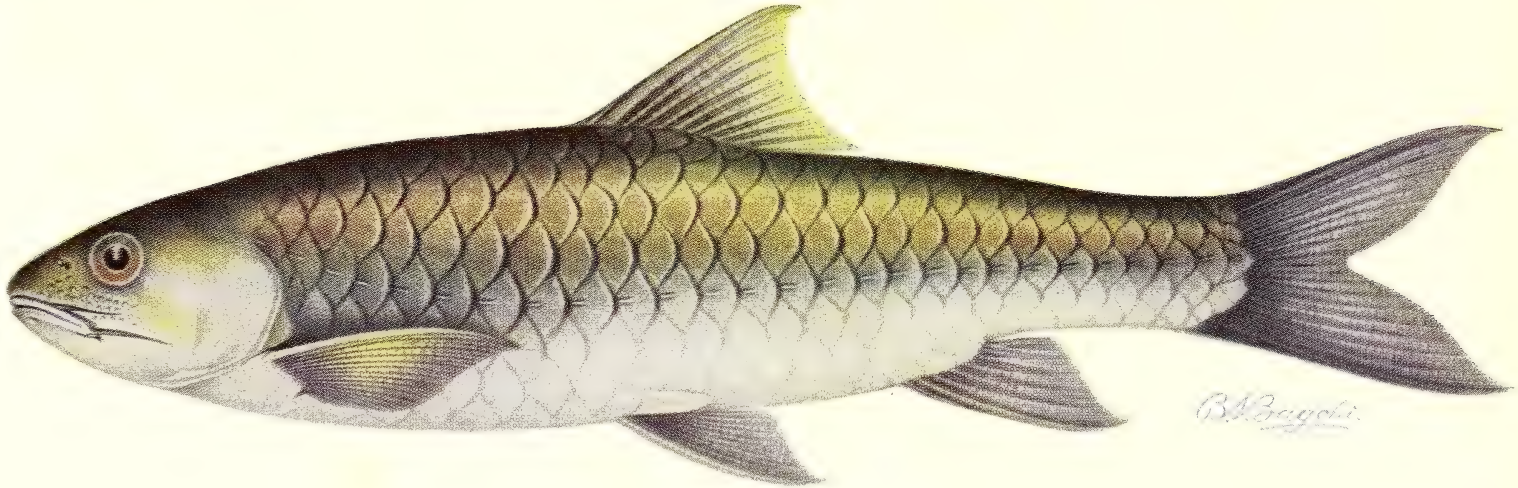
[2] Numerals in thick type within brackets refer to the serial numbers of the various publications listed in the bibliography at the end of the paper.



The Bokar of the Assamese and Katli of the Nepalese,
BARBUS (LISSOCHILUS) HEXAGONOLEPIS McClelland.

was investigated. Unfortunately, examples of only two species of the large-scaled barbels were obtained, and the systematic position of the remaining forms, therefore, still remains uncertain. For the sake of convenience of reference, I give below in a tabular form the conclusions reached so far regarding the identity of McClelland's five species:

McClelland's determination	Assamese name.	Present position.
1. *Barbus hexastichus,* pl. 39, fig. 2.	*Lobura.*	*Barbus* (*Tor*) *tor* (Ham.).
2. *Barbus progeneius,* pl. 56, fig. 3.	*Jungha.*	*Barbus* (*Tor*) *progeneius* McClelland.
3. *Barbus macrocephalus,* pl. 55, fig. 3.	*Burapetea.*	*Barbus* (*Tor*) *putitora* (Ham.)
4. *Barbus hexagonolepis,* pl. 41, fig. 3.	*Bokar.*	*Barbus* (*Lissochilus*) *hexagonolepis* McClell.
5. *Barbus megalepis.*	—	*Barbus* (*Tor*) *mosal* (Ham.).

I have not examined any examples of the specimen known as *Lobura* to the Assamese, but it may be noted that McClelland himself regarded his *Barbus hexastichus* as a synonym of Hamilton's *Cyprinus tor.* Similarly he considered his *B. megalepis* identical with Hamilton's *C. mosal.* Of the other three species, I have examined specimens of *Burapetea* and *Bokar;* the former is undoubtedly the same as *Cyprinus putitora* Hamilton—the species with the large head. The *Bokar* belongs to a totally different group of *Barbus* known as *Lissochilus,* which has not yet been recorded from the Western Himalayas; its range extends over Indo-China, Siam, Malay Peninsula and Archipelago, Burma and the Brahmaputra Drainage System. The first three species have been dealt with in the earlier articles of this subseries, while the *Bokar* Mahseer forms the subject matter of the present article. It is hoped that some specimens of *Jungha* from Assam will reach the author's hands by February, 1941, so as to enable him to deal with this species in a subsequent article.

History and Nomenclature.

The *Bokar* of the Assamese was described by McClelland as *Barbus hexagonolepis* and characterised as follows :—

'Length of the head to that of the body is as one to four; twenty-seven scales along the lateral line, and seven in an oblique line from the base of the ventrals to the ridge of the back. On the anterior part of the body the exposed surfaces of the scales represent hexagonal outlines, the fins are placed as in the preceding species, but the rays of the ventrals as well as those of the pectorals are small. The fin rays are,

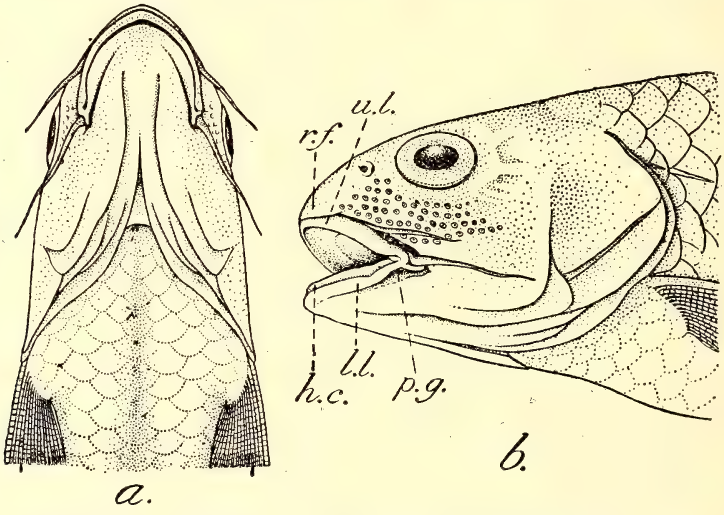
D.12 : P.16 : V.9 : A.7 : C.10/9.

'The head is small and little compressed, the snout smooth and slightly rounded, and the postorbitan plates less expanded in this than in any of the other species, having a smooth dorsal spine and large scales. In large-sized individuals the back and head, base of the fins and scales are blackish grey; but the opercular plates, scales, and fins are tipt with yellow. In young ones a leaden hue supplies the place of yellow, and the fins are tipt with black.'

Günther (**2**, p. 129) considered *B. hexagonolepis* as a synonym of *B. hexastichus*, but his description of the latter shows that he was dealing with a species of the *Tor*-type and not of the *Lissochilus*-type. Day (**1**, p. 564) recognised *B. hexagonolepis* as a valid

species and stated that 'The character of the interrupted groove behind the lower lip at once distinguishes this species from *B. hexastichus.*' He gave as its habitat 'Assam in the large rivers, and those from the Himalayas.' All the specimens referred to *B. hexagonolepis* by Day and now preserved in the collection of the Indian Museum possess pores on the cheeks though in most of the specimens the wart-like tubercles have fallen off. However, this tuberculated condition of the snout impressed Day to such an extent that he separated a few young specimens from the Tista river below Darjeeling into a separate species—*Barbus dukai.* I have examined large series of specimens from Assam and the Darjeeling Himalayas, and have not been able to separate them specifically. *B. dukai*, however, has been recorded from Siam (**6**, p. 155) and the Indo-Australian Archipelago (**12**, p. 168). Several species have since been described in the genus *Lissochilus*, but their systematic position is somewhat doubtful, and will form the subject matter of the next article when I hope to deal with the specimens of *Lissochilus* from Burma and the neighbouring areas.

In their treatment of the fishes of the Indo-Australian Archipelago, Weber and de Beaufort (**12**) recognised several genera



Text-fig. 1.—*Barbus* (*Lissochilus*) *hexagonolepis* McClelland.

a. Ventral surface of head and anterior part of body of a specimen from the Tista River, showing the interrupted post labial groove and the structure of the lower lip. *Nat. size.*
b. Ventro-lateral view of same, showing horny tubercles and the structures associated with the mouth. *Nat. size.*
h.c. Horny covering of lower jaw; *l.l.* Lower lip; *p.g.* Post labial groove; *r.f.* Rostral fold; *u.l.* Upper lip.

among the fishes hitherto grouped under *Barbus* Cuvier and proposed the genus *Lissochilus* for *B. dukai* and a new species from Sumatra. The most salient features of this genus, which distinguish it from the true Mahseers of the *Tor*-type, are :—(i) The post labial groove, though continuous round the corners of the mouth, is interrupted

in the middle (*versus* continuous); (ii) the lower lip is conspicuously separate from the jaw, which is provided with a horny covering (*versus* lower lip covering the jaw, which is devoid of a horny covering); and (iii) the snout is provided with horny tubercles or series of open pores (*versus* smooth snout). The horny covering of the lower jaw sometimes becomes inconspicuous in specimens preserved in formalin. In all other respects, these fishes are similar to those assigned to the subgenus *Tor*. For reasons detailed in an earlier article (**9**, p. 276) I think it will be useful to regard *Lissochilus* as a subgenus of *Barbus* till such time as this assemblage of forms is thoroughly monographed and the taxonomic limits of the various genera properly defined.

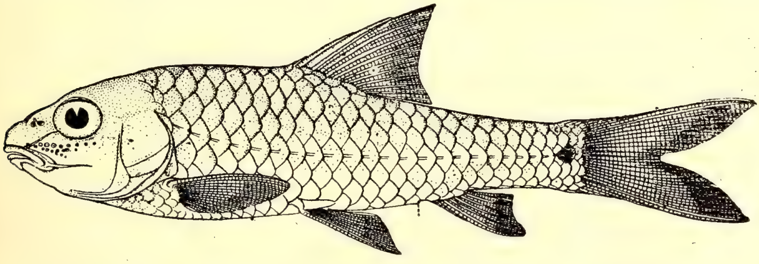
Synonymy[1] and Description.

1839. *Barbus hexagonolepis*, McClelland, *As. Res.*, XIX, pp. 270, 336, pl. xli, fig. 3.
1878. *Barbus hexagonolepis*, Day, *Fish. India*, p. 564, pl. cxxxvii, fig. 4 (pores on snout not shown, present in the specimens).
1878. *Barbus dukai*, Day, *Fish. India*, p. 564, pl. cxliii, fig. 3.
1889. *Barbus hexagonolepis*, Day, *Faun. Brit. Ind. Fish.*, I, p. 305.
1889. *Barbus dukai*, Day, *Faun. Brit. Ind. Fish.*, I, p. 306.
1913. *Barbus hexagonolepis*, Chaudhuri, *Rec. Ind. Mus.*, VIII, p. 249.
1913. *Barbus hexastichus*, Chaudhuri (*nec* McClelland), *Rec. Ind. Mus.*, VIII, p. 249.
1921. *Barbus hexastichus*, Hora (*nec* McClelland), *Rec. Ind. Mus.*, XXII, p. 186.
1924. *Barbus hexastichus*, Hora (*nec* McClelland), *Rec. Ind. Mus.*, XXVI, p. 27.
1935. *Barbus hexagonolepis*, Hora & Mukerij, *Rec. Ind. Mus.*, XXXVII, p. 389.
1936. *Barbus hexagonolepis*, Hora, *Rec. Ind. Mus.*, XXXVIII, p. 330.
1937. *Barbus hexagonolepis*, Hora, *Rec. Ind. Mus.*, XXXIX, p. 334.
1937. *Barbus* (*Lissocheilus*) *dukai*, Shaw & Shebbeare, *Journ. Roy. Asiat. Soc. Bengal. Science*, III, p. 37, pl. v, fig. 6, text-fig. 33.

Vernacular Names.—Bhorkol and *Buluk* (Bengali), *Katli* (Nepali), *Mirpunia* (Lepcha), *Kantasi* (Mechi), *Boka* or *Bokar* and *Boolooah* (Assamese).

D.4/9; P.1/13-15; V.1/8; A.3/5; C.19; L.1.22-31.

In general facies, *Barbus* (*Lissochilus*) *hexagonolepis* is similar to *B.* (*Tor*) *mosal* and has a graceful form in which both the dorsal



Text-fig. 2.—A juvenile specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from the Kalimpong Duars, showing relatively larger head and eyes, and the development of horny tubercles at this young stage. ×2.

[1] In the synonymy I have included Indian references only. References to extra-Indian records will be dealt with in the next article.

and ventral profiles are more or less equally arched. The head is relatively shorter and broadly rounded in front. The length of the head is contained from 4.5 to 5.6 times in the total length and from 3.5 to 4.3 times in the length without the caudal. The height of the head at the occiput is considerably greater than its width. The most conspicuous feature of the head is the possession of several rows of horny tubercles on the sides in front of and below the eyes. These tubercles are present in smaller numbers in specimens even below 50 mm. in length. The number and arrangement of tubercles vary in different individuals, and when the tubercles are rubbed off or fall away series of open pores are present instead. The eyes are lateral in position and are of moderate size; they are relatively larger in young specimens and are situated mainly in the anterior half of the head; the diameter of the eye is contained from 2.6 to 4.2 times in the length of the head, and according to the size of the specimen it may be greater or smaller than the length of the snout or the interorbital width. The snout is, however, shorter than the interorbital width. The mouth is of moderate size, horizontal and subterminal; it is slightly overhung by the snout. The lips are thick, continuous round the angles of the mouth, but the labial groove is widely interrupted in the middle. The posterior lip is not produced into a flap in the middle. The lower jaw is covered by a sharp, horny covering which enables the fish to rasp off encrusting organic matter from rocks. The barbels are longer than the diameter of the eye.

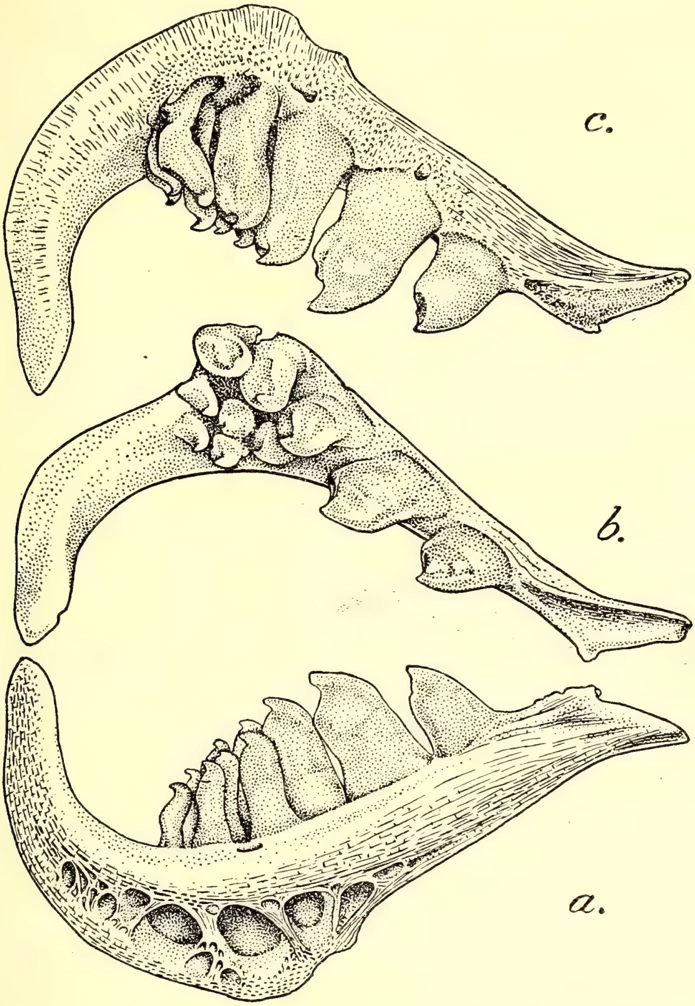
The pharyngeal teeth (5. 3. 2/2. 3. 5) are relatively shorter but more massive than those of the *Tor*-type.

With the exception of a few specimens from Pegu, I have found that the depth of the body is somewhat greater or less than the length of the head; the depth of the body is contained from 4.0 to 5.3 times in the total length and from 3.0 to 4.6 times in the length without the caudal. The caudal peduncle is well formed but narrow; its least height is contained from 1.2 to 1.7 times in its length. The scales are large and well-set; the lepidosis varies considerably even in specimens from the same locality. The number of scales along the lateral line may vary from 22 to 31, of predorsal scales from 8 to 11, and of the transverse series between the lateral line and the base of the ventral fin from $2\frac{1}{2}$ to $3\frac{1}{2}$. An examination of a large series of specimens from different localities shows that no reliance can be placed on this character for separating species. There is a scaly appendage in the axil of each pelvic fin.

The dorsal fin commences opposite to or slightly in advance of the pelvics; its commencement in half-grown specimens is generally slightly nearer to the tip of the snout than to the base of the caudal fin. The position of the dorsal varies with the size of the individuals.

The size and strength of the dorsal spine is also very variable and it has been found that specimens from streams running through lime rocks have better developed spines. The pectoral fin is low and pointed; in young specimens it may extend to the pelvic fin,

but in somewhat grown up individuals the two fins are separated by a considerable distance. The pelvic fins are also sharp and do not extend to the anal fin which latter may or may not reach



Text-fig. 3.—Right pharyngeal bone and teeth of a specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from below Darjeeling. ×4.

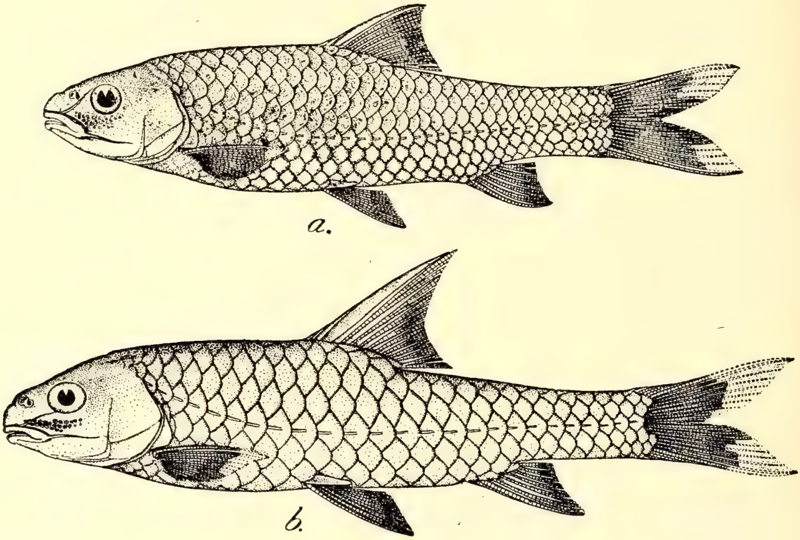
a. Dorso-lateral view, showing the pitted surface; *b.* Lateral view, showing arrangement of teeth in three rows; *c.* Ventro-lateral view.

The teeth are shorter and more massive than those of the Mahseers of the *Tor*-type.

the base of the caudal fin. The caudal fin is deeply forked with both the lobes pointed.

From the observations so far recorded, it seems that the colouration varies considerably according to the nature of the

water inhabited by the fish. The colour sketch reproduced here was made from a living specimen kept in a katchha tank at the Rungli Rungliot Tea Estate, Darjeeling District. The dorsal surface of the head and body was bottle green, the lateral band above the lateral line was yellowish brown followed by an area of king's blue colour which was replaced below by silvery white. The edges of the scales were marked with light bluish neutral tint. The tip of the snout was stone green, and the barbels had a neutral tint. There were two oval patches of a light yellow colour before and behind the eyes; the iris was yellowish brown and the gill-cover light alizarine pink. The dorsal fin had a citron green



Text-fig. 4.—Lateral view of two specimens of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland to show marked variations in lepidosis and nature of dorsal spine. *ca* $\frac{1}{2}$.

a. A specimen from the Naga Hills, Assam, with weak dorsal spine, 32 scales along lateral line and $3\frac{1}{2}$ rows between it and base of the ventral fin; *b.* A specimen from Nepal, with strong dorsal spine. 25 scales along lateral line and $2\frac{1}{2}$ rows between it and base of ventral fin.

colour, while the pelvic, anal and greater part of the pectoral and caudal fins were of a slate gray colour. There was a patch of buff colour on the pectoral and the margin of the caudal was of a light greenish neutral tint.

According to Shaw and Shebbeare (**11**, p. 38), the colour is 'Olive green on back; each scale above the lateral line copper-coloured at the end deepening to bronze-green at the base. Below the lateral line the scales are pale slate-coloured fading to pure white on the belly. Fins deep slate-colour paling towards their margins. Iris bright coppery red.'

MEASUREMENTS IN MILLIMETRES

	Eastern Himalayas, Duars and Terai							Nepal	Assam															
									Garro Hills					Naga Hills									Suddya	Lokra
Total length ...	268·0	...	207·0	...	...	80·0	50·0	215·0	253·0	144·0	137·0	100·0	73·0	298·0	277·0	190·5	185·5	...	158·5	153·0	...	...	...	140·5
Standard length ...	208·0	194·0	146·0	100·0	90·5	59·0	39·0	166·0	202·3	108·5	100·5	77·5	55·5	230·0	210·0	150·0	141·0	127·0	126·0	118·0	106·0	102·0	179·0	105·5
Length of head ...	48·0	48·0	36·7	26·5	24·0	16·5	11·0	42·0	50·0	28·5	26·5	21·0	14·5	59·5	57·0	38·0	39·0	35·0	34·5	32·0	29·0	29·0	44·0	29·0
Height of head ...	37·5	40·0	28·0	20·0	18·0	13·0	8·5	30·0	34·5	22·0	20·0	16·0	10·0	41·5	41·0	27·5	29·5	24·0	23·0	22·0	21·5	19·0	31·3	21·5
Width of head ...	30·0	32·5	23·0	15·0	13·0	11·0	6·0	25·0	28·5	18·5	17·0	12·5	9·0	34·0	36·5	23·5	23·5	20·5	20·0	18·5	18·0	15·0	25·0	18·0
Diameter of eye ...	13·6	13·5	11·0	8·5	8·0	6·2	4·0	13·0	13·5	8·5	8·4	6·9	5·0	15·0	15·0	11·0	11·0	10·5	10·5	10·0	8·5	8·2	12·0	8·5
Length of snout ...	12·3	13·0	12·0	8·5	7·0	5·0	3·0	12·0	16·4	8·3	8·0	6·9	4·0	19·0	20·0	11·0	12·0	11·5	10·3	9·0	9·0	8·8	14·0	8·5
Interorbital distance.	18·5	17·0	13·9	9·5	7·5	5·0	3·0	16·0	17·0	8·5	9·0	6·5	4·5	24·0	21·0	14·0	14·0	11·5	11·0	10·0	10·0	8·8	15·5	10·3
Depth of body ...	55·0	51·0	44·0	28·0	28·3	15·0	9·5	42·0	50·0	30·5	30·0	21·7	15·5	69·0	55·0	41·0	39·0	35·0	34·5	32·0	27·0	26·0	38·5	33·0
Width of body ...	32·5	28·7	25·0	14·0	13·0	9·0	5·0	22·0	26·3	16·5	16·0	12·3	9·0	35·5	35·0	21·5	22·0	18·0	18·3	17·0	16·0	14·5	21·0	17·0
Length of caudal peduncle ...	33·5	35·0	25·5	14·5	14·5	9·2	7·0	26·0	32·5	19·5	18·0	14·0	9·3	39·0	34·0	27·0	25·5	24·0	22·0	21·0	17·0	16·5	32·5	16·5
Least height of caudal peduncle ...	24·5	23·5	18·5	10·5	10·5	7·5	4·9	18·0	22·5	13·0	12·7	10·0	6·5	26·0	24·0	18·0	16·5	14·5	14·0	13·0	11·0	12·5	20·0	13·0
Length of dorsal fin.	40·5	41·8	35·5	D.	22·0	15·0	10·0	47·0	38·5	27·5	24·0	21·0	13·0	50·5	42·0	32·5	28·0	28·5	26·5	25·5	22·0	22·3	37·0	26·0
Length of pectoral fin ...	46·0	39·3	31·5	20·5	20·0	13·6	7·5	D.	43·0	25·0	21·0	17·3	11·0	50·0	50·0	31·5	32·0	27·5	27·5	27·5	23·5	21·0	35·0	23·0
Length of pelvic fin.	39·0	34·0	26·6	19·5	16·0	12·5	6·5	31·5	37·5	20·5	18·5	14·0	9·0	40·5	35·0	25·2	27·0	22·5	20·5	19·0	18·5	18·0	28·5	18·5
Length of anal fin. ...	47·0	34·0	27·0	17·5	14·0	12·0	6·5	35·0	38·0	23·0	20·0	13·0	9·5	38·0	40·5	25·0	30·0	24·0	23·0	18·5	18·0	18·0	32·5	21·5
Length of rostral barbel ...	14·5	13·5	11·9	7·0	5·5	5·3	2·5	12·0	17·0	10·0	9·0	7·8	4·5	12·0	13·5	11·0	12·5	11·5	10·5	10·0	8·0	7·0	12·0	10·5
Length of maxillary barbel ...	17·5	18·0	13·0	9·0	7·0	7·5	2·9	13·0	18·0	10·5	10·0	7·0	4·3	14·0	15·0	13·0	14·0	13·0	11·5	12·0	10·5	8·0	12·0	12·0
Number of predorsal scales ..	10	10	9	9	9	8	9	8	9	9	10	10	10	11	10	11	10	10	10	10	8	10	11	9
Number of scales along lateral line.	27	27	25	27	25	25	26	25	27	27	27–28	28	28	30	30	32	30	30	30	28	25	27	31	26
Number of scales between lateral line and v. ...	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	3½	3	3½	3	3	3	3	2	2½	3	2½

Distribution and Size.

Though the final distribution of the species will be discussed in the next article after an account of the extra-Indian material, it may be noted that *B. hexagonolepis* is perhaps the commonest large-scaled Barbel of Assam and of the Eastern Himalayas. In the collection of the Indian Museum there are numerous specimens from the Eastern Himalayas, the Garo Hills, the Khasi Hills, the Naga Hills, and several other places in Assam. There is also a specimen from Nepal. The species has not hitherto been recorded from the Ganges River System or any other part of India.

Both McClelland and Day have noted that this species grows to upwards of two feet in length. Shaw and Shebbeare state that 'Rarely, if ever, exceeding 10 lb. in our area, but W. Nelson records a *Katli* of 25 lb. caught by him in the Champamoli near Gorubasha (Assam).'

In a recent note Holt (4, p. 154) recorded the capture of a *Katli* weighing 21 lbs. from Jaldacca, so it would appear that in Duars also the fish grows to a fairly big size. Mr. S. J. Duncan informed me (*vide* 8, p. 334) that this was the mighty Mahseer of the region traversed by him and that it was found in almost all the rivers of the hills.

Bionomics and Fishing Notes.

McClelland (**10**, pp. 336, 337) made the following observations regarding the bionomics of *B. hexagonolepis*:—

'The stomach is about the length of the body, gradually contracting till it joins the intestines, which are thrice the length of the stomach, but of great capacity, expanding in size from their commencement, to about the middle of their length, and again gradually contracting until they reach the vent. In the stomach and intestines I found numerous minute bones of small fishes. Instead of the intestines of this species being disposed in transverse or longitudinal folds, they are convoluted transversely. Mr. Griffith remarks that the *Bokar* is to be found in all large rivers on the eastern frontier, from the base of the mountains to the situation at which the currents first become languid in the plains, keeping mostly in the middle of the stream, where it takes a red hackle very freely, as well as worms and other bait. It is very powerful, often attaining two feet and upwards in length, and usually weighing from eight to twelve pounds.'

Wood (**13**, pp. 71, 72) in his notes on *Fishing in India and Europe* recorded the following observations regarding *Booka* or the snub-nosed Mahseer:—

'The *Booka* or snub-nosed Mahseer. This is a true Carp and the colour is duller than in the last; the fins are bluish-red and the pharyngeal teeth are broader and flatter. As the *Booka* is not such a cannibal as the true Mahseer, feeding more on falling fruits, weeds, grasses, etc., it does not attain to a very great size, 12½ lbs. being the heaviest I ever got. A curious thing about him is that his fins are never entire, pieces especially in the caudal fin being bitten out. The Khasias have told me that this is done by a little fish with a beak like a parrot and which can blow itself out. They call it the *Poothla Mas*. I have seen little boys blowing these fish up as one does a toy balloon. Sometimes when bathing these fish will nip your legs. The Khasias hate the *Booka* and many will not eat them, as they say they devour the excrement of monkeys. I fancy there is something in this. A fruit which they are fond of, a species of small fig is often found on

trees overhanging the water. I have seen hosts of monkeys feeding on the berries and when the fruit[1] fell into the pool below it was eaten by the *Booka* and other fish; the excrement also dropped into the water and I do not think the *Booka* would object to eating this. The *Booka* does not make the terrific rush like the Mahseer, he rather bores down into the depths of the water and shakes the line like a bull dog. By this feeling you can always tell you have a *Booka* on. They take a G and S spoon well but one has to spin deep for them and in a pool they soon get scared of a spoon. During a sudden heavy spate, when the river gets muddy like pea soup, I have seen *Booka* spring into the air to get more oxygen. The teeth of the true Mahseer are much longer and pointed than those of the *Booka,* some having a distinct notch. They play on a hinge system and the teeth point downwards into the pharynx. They are admirably adapted for cutting purposes and their strength can be gauged by putting one's fingers down the throat of a small Mahseer.'

Shaw and Shebbeare (**11**, p. 38) noted that the habits of *Katli* are 'Very similar to those of the Mahseer. As a sporting fish there is nothing to choose between them, weight for weight. It is unfortunate that, as both take the same lures, and are found in the same water, the smaller species is often taken on much too heavy tackle which does not give him a chance to show his power.'

Acknowledgments.

I am indebted to the authorities of the Bombay Natural History Society for bearing the cost of the illustrations for this article. Mr. K. S. Misra very kindly prepared the table of measurements and for this my thanks are due to him. The colour sketch was made from a specimen caught by Mr. W. K. Langdale Smith of the Rungli Rungliot Tea Estate, Darjeeling District, from the Tista River and later kept by him in a Katchha tank. I am indebted to Mr. Langdale Smith for affording facilities to my artist to make the colour sketch. The illustrations were prepared by Babu B. Bagchi with his usual skill and care under my supervision.

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[1] In this connection reference may be made to Hopwood's (**5**) observations on 'Effect on Mahseer of eating the fruit of the Kalaw tree (*Taraktogenos Kurzii*)'. The flesh of the fish which eat the fruits of this tree becomes poisonous.

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Explanation of Plate.

Colour sketch of a tame Katli, *Barbus* (*Lissochilus*) *hexagonolepis* McClelland of the Tista River.

The specimen, 268 mm. in total length, was collected by Mr. W. K. Langdale Smith, and kept in a katchha tank at the Rungli Rungliot Tea Estate, Darjeeling District. The colours shown in the drawing probably differ from those of specimens living under natural conditions.

A CONTRIBUTION TO THE LIFE HISTORY OF *TRIDAX PROCUMBENS* LINN.

BY

I. BANERJI.

(*Department of Botany, Calcutta University*).

(*With two plates and 25 text-figures*).

The family Compositae includes over 23,000 species and contains about one-tenth of the total number of flowering plants. It is distributed throughout the world, and the plants show remarkable diversity in habit.

Although a considerable amount of work has been done on the embryology and cytology of the plants belonging to the family Compositae our knowledge is far from complete. Schnarf (16) and Bhargava (3) have reviewed the vast literature on the subject. It is interesting to note that various types of embryo-sac development, as also variation in the number and structure of antipodal cells have been recorded in different species. The literature on the cytology of the family is also very extensive. Of the interesting observations made in recent years, mention may be made of the occurrence of secondary association of chromosomes and polyploidy in several genera. Meiotic irregularities leading to the formation of sterile or multinucleated pollen grains, as also the parthenogenetic development of the egg have been recorded by several investigators.

Tridax procumbens is a common weed found in all waste places in Bengal. The plant flowers during the greater part of the year and is easily recognised in its natural environment by its straggling habit, opposite pinnatifid leaves and long pedunculated flower—heads containing pale yellow coloured ray florets.

MATERIAL AND METHODS.

The material used in this investigation was obtained from plants growing as weeds in the college compound. Fixation was usually made between 12 noon and 4 p.m. Various fixing fluids were tried of which Allen's modified Bouin's fluid, and Flemming's weak solution gave the best results. The involucral bracts were removed before fixation and the flower-heads were cut into small pieces to facilitate penetration of the fixing fluid. An exhaust pump was always used for the same purpose. The material was dehydrated and cleared in the usual way. Sections were cut 8 to 14 microns thick, depending on the stage required for study. Heidenhain's iron-alum haematoxylin and Newton's iodine gentian violet were the stains commonly used.

OBSERVATIONS.

1. *Flower development.* The flowers are arranged in long pedunculated heads which are about 1/3 to 1/2 inch in diameter. The ray florets are carpellate and the disc florets hermaphrodite. The opening of the florets is

centripetal, and the disc florets become differentiated first. The individual florets appear on the convex floral axis as minute papillate processes, each subtended by a bract (Fig. 1). The apex of the flower primordium very soon curves inwards and develops into the corolla. (Fig. 2). The primordia of the stamens, five in number, are seen to arise on the inner side of the petals (Figs. 3 and 4), and rapidly grow upwards and become differentiated into

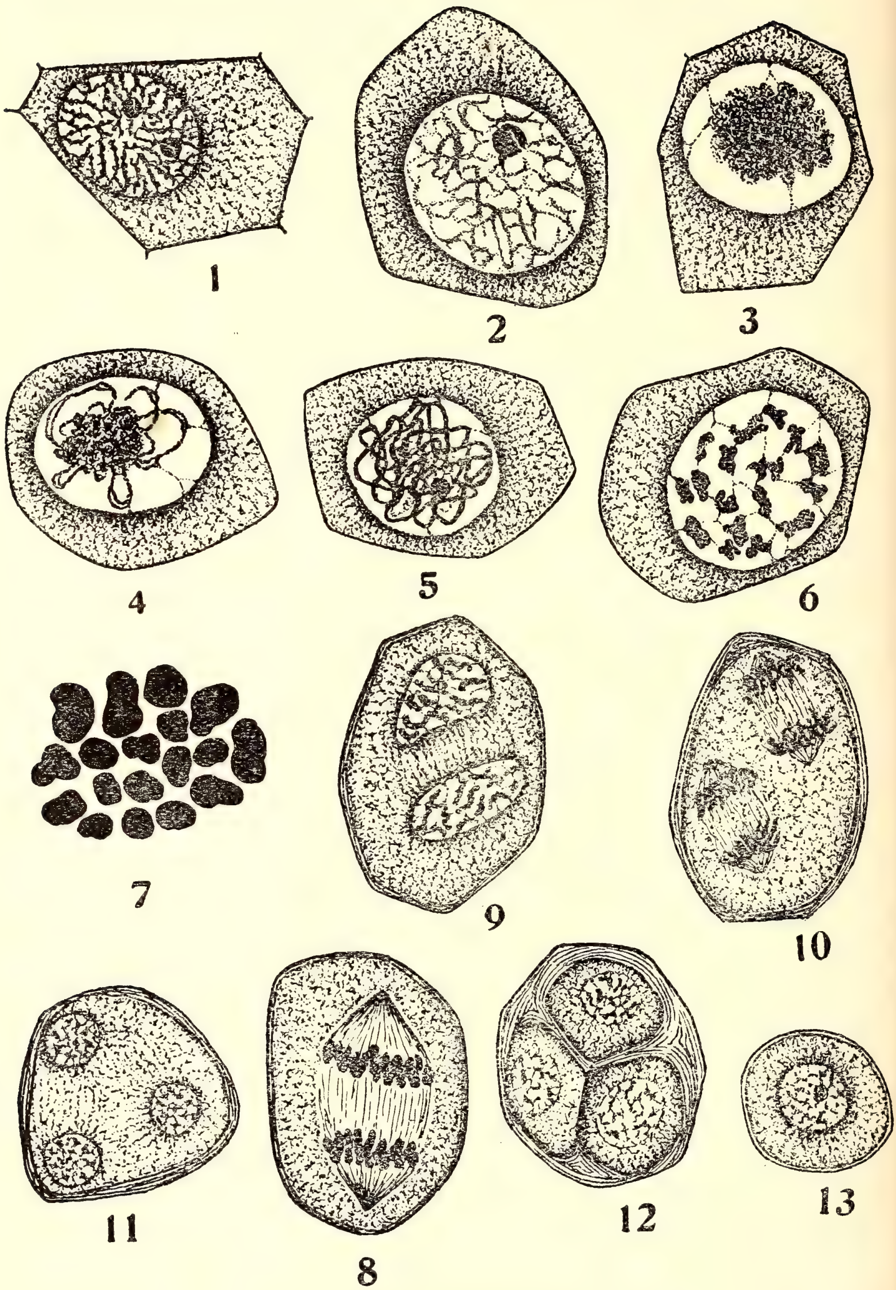
Figs. 1-6.—*Tridax procumbens.* Figs. 1-5, Stages in the development of the disc florets. Explanation in text. Fig. 6, Part of pappus showing arrangement of cells. Figs. 1-5, ×940; Fig. 6, ×430.

comparatively large anthers and small filaments. Immediately after the appearance of the staminal primordia, the origin of the sepals is noted. In longitudinal sections of the flower these appear as two scale-like projections on the outer side of the petals (Fig. 5). In the initial stages of their development they are composed of a few cells, but later develop into hairy structures known as 'pappus'. Figure 6 represents the arrangement of the cells composing the pappus. A spindle shaped nucleus is seen in each cell. The last floral whorl to appear is the gynaecium composed of two carpels which arise on the inner side of the stamens and close to the centre of the floral axis. In the early stages of their development they remain side by side, but with increased growth their distal ends come together to form the solid style, while their proximal ends separate out to form the ovarian chamber. The carpels open out again at the apex to form the bifid stigma. The stigma is clothed by unicellular subulate hairs. From the base of the ovary a papillate protuberance develops which at first grows obliquely upwards, but very soon curves to form the single anatropous ovule.

The development of the ray florets is similar to the above, except that the corolla becomes ligulate and the stamens are absent. The style in both types of flowers is surrounded at the base by a ring of glandular tissue. Figures 1 to 5 represent stages in the development of the disc florets.

The sequence of development of the floral parts appears to be similar to that observed by Martin (10), Merrell (11), and others.

2. *Microsporogenesis.* The origin of the archesporial cells, or the early differentiation of the sporogenous cells could not be made out. When first noted the sporogenous cells appear to be separated from the epidermis by



1 2 3 4 5 6 7 9 10 11 8 12 13

Tridax procumbens Linn.

For explanation see end of article.

four or five layers of cells. In the resting stage the sporogenous cells are packed close together in the anther loculus and they are mostly polygonal in outline. The nucleus is generally situated centrally inside the cell and contains a single nucleolus surrounded by a hyaline zone. At the periphery of the nucleus a granular reticulum is noted. With the onset of prophase a number of elongated and beaded threads are seen to lie scattered irregularly inside the nuclear cavity. (Plate I, fig. 1). The double nature of the threads could not be very clearly made out, but from their beaded appearance it is inferred that they are composed of two filaments which are spirally intertwined. Close approximation of the leptotene threads next takes place. Figure 2 in plate I represents a typical zygonema stage. The threads next contract away from the periphery of the nucleus and ball up into a tight knot. (Plate I, fig. 3), the nucleolus being enclosed in the meshes of the thread. Synizesis lasts for a long time as is evidenced from a large number of preparations showing this stage. The spireme next opens out and gradually fills up the nuclear cavity. Careful examination at this stage reveals the double nature of the spireme (Plate I, fig. 4). At the pachynema stage the spireme appears as a uniform thread which lies loosely convoluted inside the nuclear cavity. (Plate I, fig. 5). At this stage the nucleolus decreases in size and its chromaticity also becomes reduced. The pachytene thread next segments into a number of unequal bits. These synapsed portions separate out markedly except at the portions where chiasmata are established. The four-partite nature of the diplotene threads is evident at certain regions only. The number of chiasmata depends on the length of the threads. As a rule the number varies from five to two (Text fig. 7). Some of the longer pairs have three interstital and two terminal chiasmata, while others have one interstital and two terminal chiasmata. In some others, especially in the shorter ones, two terminal chiasmata are seen. In later diplotene stages there is a reduction in the number of chiasmata and

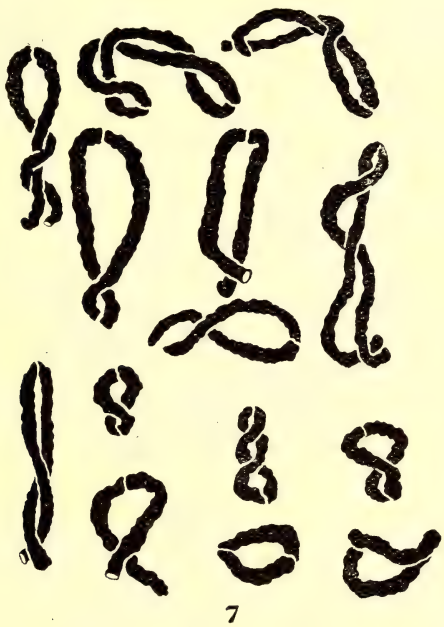


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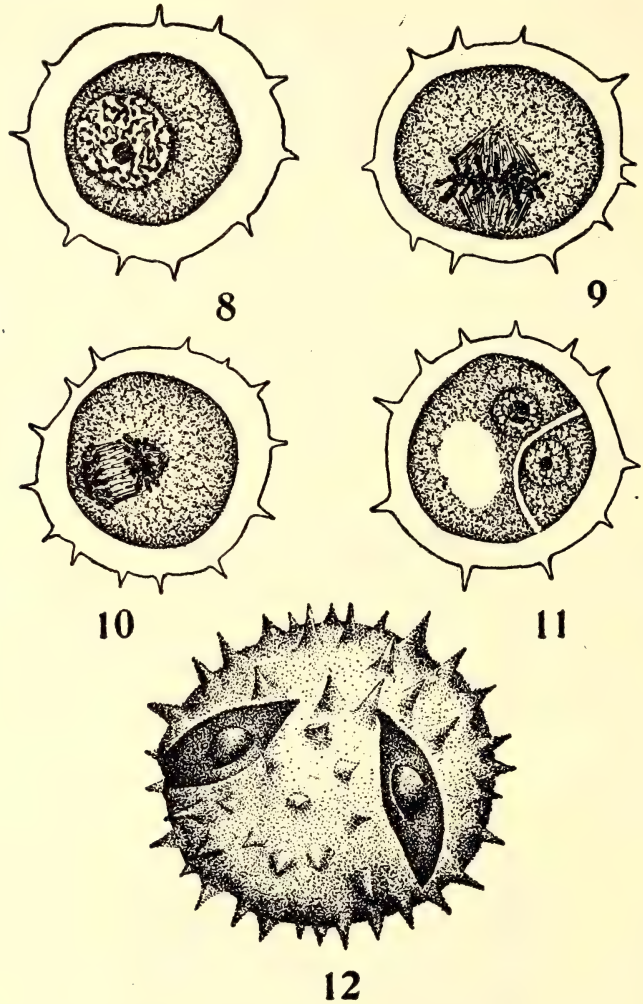
Fig. 7.—*Tridax procumbens.* Some of the diplotene bivalents showing the number of chiasmata and the spiral nature of the strands × 3650.

a shifting of their positions towards the ends. Terminalisation of the chiasmata appears to be complete in every instance and at diakinesis the bivalents are seen to lie side by side. (Plate I, fig. 6). The nucleolus becomes still smaller and paler and finally disappears at this stage. The heterotypic spindle is next

noted. The spindle is well defined with sharp ends, and the bivalent chromosomes are aligned on the equatorial region. A polar view of an equatorial plate shows clearly eighteen bivalent chromosomes. (Plate I, fig. 7). The anaphasic movement of the chromosomes appears to be regular (Plate I, fig. 8). Non-disjunction or other meiotic irregularity has not been noted at this stage.

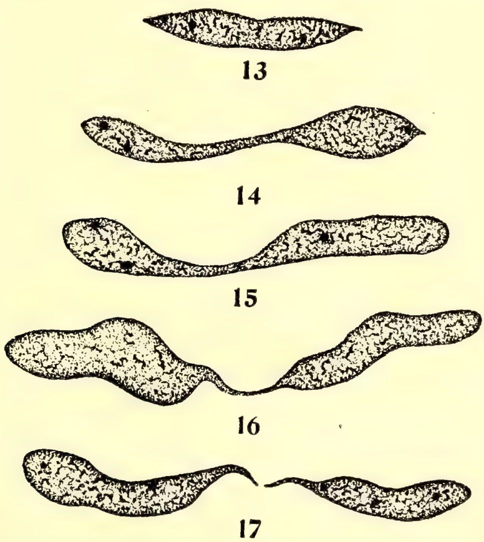


Figs. 8-12.—*Tridax procumbens.* Fig. 8, Microspore nucleus in prophase. Figs. 9 and 10, Division of the microspore nucleus. Fig. 11, Tube and generative nucleus separated by an ephimeral cell membrane. Fig. 12, A mature pollen grain (mounted in a liquid medium); note germ-pores and sculpturing on the exine. Figs. 8-11, ×1555; Fig. 12, ×3650.

On reaching the poles the chromosomes at first clump together, but very soon they open out and their spiral nature is once more apparent. A nuclear membrane is secreted and the two daughter nuclei are connected by cytoplasmic strands (Plate I, fig. 9). The spindles are oriented either at right angles, or parallel to each other. The chromosomes while oriented on the spindle appear to be somewhat elongated (Plate I, fig. 10). On the completion of the second

division four daughter nuclei are organised, inside which irregularly coiled threads are noted (Plate I, fig. 11). The microspore tetrads are either isobilateral or tetrahedral in arrangement and are encased by a mucilaginous pellicle (Plate I, fig. 12). Cytokinesis takes place by the advancement of peripheral furrows which meet at the centre of the protoplast. Quadripartition by furrowing is now believed to be the general method of cytokinesis in dicotyledonous plants. The young microspores are at first enclosed in the mucilaginous pellicle, but as the latter gradually undergoes dissolution they are liberated and lie free inside the microsporangium. At this stage they have a wavy outline but very soon they round up and the exine becomes differentiated. The nucleus of the microspore increases in size and prepares for division. The various stages of the division are shown in text figures 8 to 10. The nucleus migrates towards the periphery before the commencement of division and the metaphase spindle lies at one side (Fig. 9), and occupies more than half the diameter of the microspore. According to Wulff and Maheshwari (19) this is the general condition in angiosperms though exceptions have also been recorded. On the completion of division two cells are formed which are unequal in size and are separated by a cytoplasmic membrane. The generative cell, as in most plants, is lens-shaped and lies close towards the periphery. Its nucleus is slightly smaller than that of the vegetative cell (Fig. 11). Geitler (6) believes that this might be due to the small amount of karyolymph present in the generative nucleus. The mature pollen grains are two celled, and ellipsoidal, but become spheroidal when mounted in a liquid medium. Their diameter varies from 32·5 to 36·8 microns. They are echinate, the spines having a broad base. Four broad and short furrows with tapering ends are present, each having a single germ pore, from the centre of which the intine protrudes as a tiny papilla (Fig. 12). The intra-colpar regions show the presence of vestigial spines.

3. *Periplasmodium.*—In the early stages of meiosis the tapetal cells are uninucleate and somewhat elongated. Before the pollen-mother cells have completed the I division, the nuclei of the tapetal cells divide mitotically and the cells become binucleate due to the non-formation of a cell wall. The two



Figs. 13-17.—*Tridax procumbens.* Stages in the amitotic division of the tapetal nuclei, ×1555.

nuclei mostly lie side by side. During the tetrad stage of the pollen mother cells, the first indication of plasmodium formation is observed. The walls delimiting the individual cells disappear and their cytoplasm coalesce and protrude inside the anther cavity. As this process takes place from all sides, the microsporangium is soon filled by the tapetal plasmodium which closely surrounds

the young microspores. The tapetal nuclei before migration into the anther cavity become very much elongated. They show the presence of fine chromatin granules and a few small nucleoli. At a later stage they are seen to divide amitotically. Text figures 13 to 17 represent the various stages of division. The daughter nuclei formed as a result of the disorganisation of the constricted area, withdraw the attenuated portion very soon and become elongated in form. They remain in this condition till the disappearance of the plasmodium when they degenerate.

The formation of a tapetal plasmodium has been recorded in many plants of the family Compositae. Merrell (11) working on *Silphium* observed the collection of plasma around the microspores which later became encrusted by it in the form of a sheath. Gates and Rees (5) state 'the plasmodium flows in among the pollen grains and may contribute directly to the sculpturing of the wall'. Similar observations have been made by the present writer (1) working on *Carthamus tinctorius*. In *Tridax procumbens* though the plasmodium was seen to be in intimate contact with the spinous projections of the exine, yet in the absence of further evidence it would be unsafe to suggest that the plasmodial substance is incorporated on the exine. The plasmodial substance is finally resorbed so that hardly any trace of it is left in the anther.

4. *Multi-nucleated pollen mother cells.* During the later stages of meiosis when the pollen mother cells have rounded up, in some anthers a few large cells have been noted. As a rule not more than one such cell is present in the anther and it lies close towards the periphery. These cells contain two, three or four nuclei. (Plate II, fig. 14). The nuclei in most cases show the early prophasic changes, while the surrounding pollen mother cells show all stages from diakinesis to pollen tetrads. Figure 15, in plate II, represents a stage in which the presence of eight nuclei is seen in the protoplast. From the form and arrangement of the nuclei it appears that they are the product of division of pre-existing nuclei. The nuclei being probably in the interkinetic stage. Figure 16 in the same plate illustrates another stage where the nuclei are in a state of division. Seven telophasic spindles with polar grouping of chromosomes are clearly seen. From the occurrence of a chromosome group at the position marked x in the diagram one is inclined to believe that another spindle is present at that region, probably masked by the adjacent chromosome groups. This condition would then represent an advanced stage to that observed in figure 15. (Plate II). But it is very rare, and has been observed in only one preparation out of a large number examined. Mostly the multi-nucleated pollen mother cells degenerate early, as is evidenced by their collapsed and irregular outlines and the presence of large dark shapeless masses in the anther. In no preparation was any giant microspore observed nor a polycaric condition of the pollen grains noted.

5. *The development of the megaspores and the female gametophyte.* The ovule arises as a tiny protuberance from the base of the ovary when the sporogenous cells have just become differentiated in the anther. It grows obliquely upwards and curves inwards even before the differentiation of the megaspore mother cell. The curvature of the ovule is not brought about by its contact with the ovarian wall as has been noted by Reeves (15) in *Medicago sativa*. The direction of curvature of the ovules is not the same in all florets.

The archesporial cell becomes differentiated in the hypodermal layer of the nucellus and directly functions as the megaspore mother cell. (Fig. 18). The megaspore mother cell increases in size and then passes through the usual stages of reduction division (Figs. 19 and 20), and a linear tetrad of four megaspores is produced in every instance (Fig. 21). The nucellus is greatly reduced and consists of a single layer of cells lining the megaspores, which are completely encased by the integument. The lowest or the chalazal megaspore always functions, while the rest degenerate and could be made out by their dark shapeless masses capping the functional megaspore. The functional megaspore increases in size before division. The two nuclei produced as the result of division show distinct polarity, and at this stage degeneration of the surrounding cells of the nucellus is first noted. The quadri nucleate stage is next reached and the embryo-sac becomes encased by the radially elongated cells of the integument. This condition appears to be a characteristic feature in the family Compositae, and the inner cells of the

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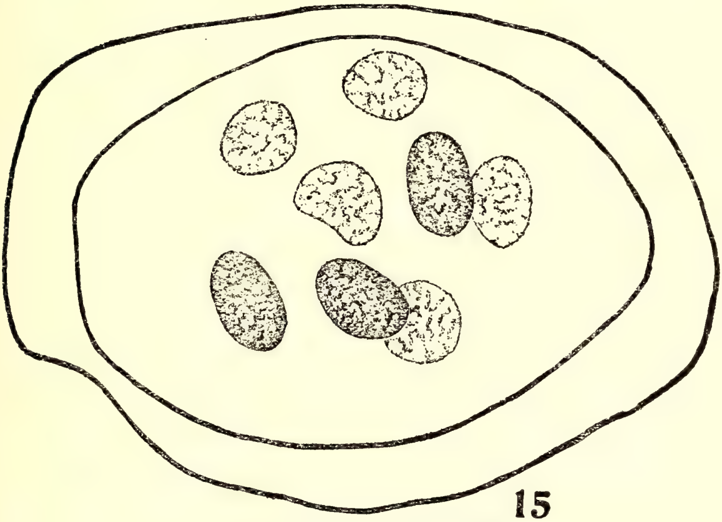

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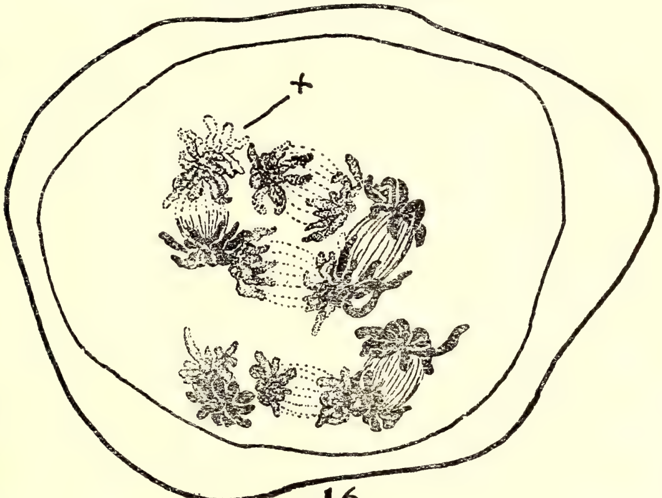


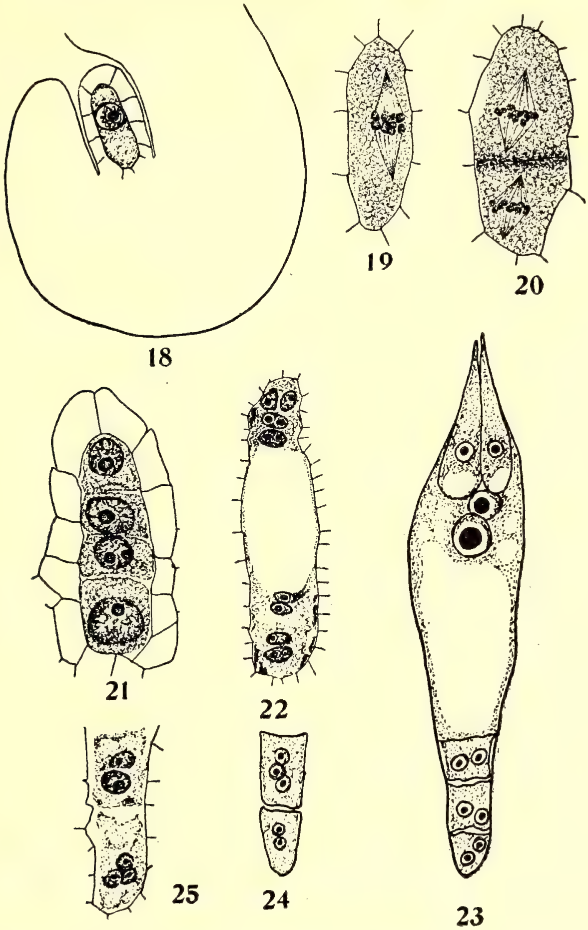
16

Tridax procumbens Linn.

For explanation see end of article.

integument have often been referred to as the 'integumental jacket'. The eight nucleate stage is next reached and the embryo-sac shows considerable increase in size.

The mature embryo-sac is of the normal angiospermous type (Fig. 23). The synergids are pear shaped and have prominent beak like processes which extend inside the micropyle. A big vacuole occurs at the base of each synergid at the top of which the nucleus is placed. The egg is very much elongated,



Figs. 18-25.—*Tridax procumbens*. Fig. 18, Longitudinal section of the ovule showing the hypodermal origin of the megaspore mother cell and the single integument. Fig. 19, Heterotypic division of the M.M.C. Fig. 20, Homotypic division of the M.M.C. Fig. 21, Tetrad of megaspores. Fig. 22, Eight-nucleate embryo-sac. Fig. 23, Mature embryo-sac, the antipodal cells bi-nucleate. Fig. 24, Antipodal region of an embryo-sac, showing two antipodal cells, of which the upper one is three-nucleate and the lower binucleate. Fig. 25, Same, showing two anti-podal cells, the lower cell has three nuclei and the upper two. Fig. 18, ×430; Figs. 19-21, ×1050; Figs. 22-25, ×940.

it lies below the synergids and shows the usual form. The secondary nucleus lies very close to the egg. It is bigger than the egg nucleus and is surrounded by a dense mass of cytoplasm. The three antipodal cells which are separated

from one another by cytoplasmic membranes lie at the chalazal end of the embryo-sac. At first they are uni-nucleate, but very soon become binucleate. In a few instances only two antipodal cells have been noted in the mature embryo-sac. Of these cells sometimes the upper one was seen to be trinucleate and the lower binucleate (Fig. 24), or the reverse condition prevailed (Fig. 25).

Discussion.

1. *Meiosis.*

The spiral structure of the chromosomes first observed by Baranetsky (4) has now been definitely established. There are, however, different views regarding the number of spirals that compose the prophase chromosomes. Among the recent investigators on the subject Nathany (12), Huskins and Smith (8) and others are of opinion that the leptotene threads are single, while Koshy (9) and others believe that they are double. In *Tridax procumbens* the leptotene threads appear to be beaded, which is probably due to the close intertwining of two threads forming nodes and internodes. Such appearance of the leptotene threads has been observed by Koshy (9) in *Aloe littoralis,* and he is of opinion that the beaded nature is due to two closely intertwined chromonemata. The structure of the chromosomes during the later stages of meiosis could not be made out clearly on account of the unsuitability of the material for such investigation. The chromonematic structure of the chromosomes again becomes apparent in the interkinetic nuclei and in the nuclei of young microspores. It thus appears that each chromosome is composed of two spirally intertwined threads. Further indication of the spiral nature is obtained in the diplonema stage where the wavy outline of chromosomes is suggestive of the existence of coiled strands.

The method of chromosome conjugation is parasynaptic. The pairing of the leptotene threads is apparent in the early prophasic stages and as the spireme recovers from synizesis, its double nature is evident at places. The absence of a 'second contraction' stage and the segmentation of the spireme to give rise to the bivalent chromosomes lend support to this view. Gates and Rees (5) working on *Lactuca* have observed a looping of the spireme during the second contraction stage. The number of loops corresponded to the number of chromosomes, and it was concluded that each loop represented a pair of chromosomes which later separated out. The above observation led the authors to believe that synizesis in *Lactuca* has no part in bringing about the pairing of the threads. It is difficult to accept this view as the observations on *Tridax* indicate that synizesis is a critical stage when the pairing of the threads takes place.

Great variation in the number of chromosomes has been noted in the family Compositae. Tischler (17) gives a list of the numbers recorded till recently. Of the plants under the tribe Helianthoidae the chromosome numbers of the following have been recorded: *Xanthium Strumarium, X. italicum, X. inflexum* and *X. pensylvanicum* ($n=18$); *Galinsoga parviflora* ($n=18$); *Helianthus annuus* ($n=17$); *Bidens sp.* ($n=24$). It is interesting to note that *Tridax procumbens* possesses 18 haploid chromosomes and thus shows chromosomal affinity with some other plants of the tribe to which it belongs.

2. *Multi-nucleated pollen mother cells.*

The presence of large multi-nucleated pollen mother cells in the microsporangium during the later stages of meiosis is an interesting feature in *Tridax.* Careful examination of the synizetic and presynizetic stages failed to show the presence of such cells, and it can therefore be concluded that these cells are not differentiated as such during sporogenesis. The origin of these cells might be due to the union of the cytoplasm of two or more pollen mother cells or to a process of nuclear migration or cytomyxis. As the latter conditions have not been observed in any preparation, it is likely due to the former. Besides, measurements show that the size of the nuclei in the large pollen mother cells is nearly the same as those of the ordinary meiocytes in the same stage of meiosis. The number of separate nuclei in the protoplast indicates the number of pollen mother cells involved in the process. Gates and Rees (5) have observed similar bi-nucleate pollen

mother cells in *Lactuca.* These were noted in the presynizetic and synizetic stages of the pollen mother cells and not later. It has been suggested that these cells owe their origin through a breakdown or due to the incomplete formation of a cell membrane between the two cells. The absence of any evidence in that direction and the presence of multi-nucleated cells in *Tridax procumbens* makes this interpretation difficult to accept. Holmgreen (7) has observed quadrinucleated pollen grains in *Erigeron eriocephalus* and *E. malaschkensis.* According to him these resulted from the failure of wall formation after reduction division. Non-formation of walls after reduction division appears to be the condition in *Tridax* also, and it results in an increase in the number of nuclei. Such a condition is illustrated in figures 15 and 16, plate II. In the first figure, the arrangement of the nuclei indicates that they have just completed the division and are in the interkinetic stage, while in the second figure, all these eight nuclei are in a state of division. The large eight-nucleated cell (Fig. 15, Plate II), therefore must have resulted from the coalescence of the cytoplasm of four pollen mother cells, and not as a result of non-formation of wall after reduction division. Besides, as in most other cases the nuclei of the aberrant pollen mother cells are seen in early prophase, they could not have possibly resulted from a process of division as suggested by Holmgreen (7).

3. *Tapetal plasmodium.*

The tapetal cells become bi-nucleate in the early stages of meiosis. Quadrinucleate tapetal cells as reported by many workers on Compositae have not been observed. A true plasmodium was formed during the later stages of meiosis and as the tapetal nuclei migrated inside the microsporangium, they became very much elongated and divided amitotically. Similar amitotic division of the tapetal nuclei has been noted by the present writer (2) in *Colocasia antiquorum.* Bhargava (3) has noted the occurrence of a tapetal plasmodium in *Eclipta erecta*—a member of the tribe Helianthoideae—but he does not mention the amitotic division of the tapetal nuclei.

4. *Pollen grains.*

In recent years the study of pollen morphology has received considerable attention. Wodehouse (18) states—'pollen grains of the same species and of closely related species tend to be alike, and if the environmental factors are alike, the degree of their similarity is a measure of their closeness of relationship'. The pollen morphology of a few plants belonging to the tribe Helianthoideae has so far been studied. *Helianthus annuus, Xanthium cathartícum, Chrysanthemum coccineum, C. morifolium, C. carinatum* and *Eclipta erecta* could be mentioned in this connection. The size of the pollen grains in this tribe does not show great variation. The pollen grains of the different species of *Chrysanthemum* studied, range between 26·6—36·5 microns in diameter, while those of *Xanthium, Helianthus* and *Eclipta* are 20·9, 27·7 and 18·0 respectively. The diameter of the pollen grains of *Tridax procumbens* has been found to vary from 32·5 to 36·8 microns (with spines).

Wodehouse (18) has observed the pollen grains of the different species of *Chrysanthemum* studied by him to be tetra- or hexa-colpate. It is interesting to note that the pollen grain of *Tridax* are also tetracolpate. In general, the pollen grains are similar to those of *Helianthus.*

The shape of mature pollen (mounted dry) of *Tridax procumbens* is ellipsoidal. This agrees with the observation of Wodehouse (18) on other members of the tribe Helianthoideae. Bhargava (3) however, states that the pollen grains of *Eclipta erecta* to be spherical and questions Pope's (14) observation on other Compositae. In *Tridax* the ellipsoidal condition is due to harmomegathy of the germinal furrows and the pollen grains assume a spheroidal form when mounted in a liquid medium. In the light of our present knowledge, a careful re-examination of the pollen grains of *Eclipta erecta* seems to be necessary.

5. *Development of the female gametophyte.*

The development of the megaspores and the female gametophyte is of the normal type. It is interesting to note that in the few plants of the tribe Helianthoideae so far investigated, the same type of embryo-sac development prevails. The variability in the number of antipodal cells and their nuclei, as

observed in the material investigated, appears to be a characteristic feature of this tribe. Fusion of the nuclei of the antipodal cells as observed by Palm (13) in *Zinnia* was not seen in any preparation.

Summary.

The paper gives an account of the development of the flower, pollen grains and the female gametophyte of *Tridax procumbens*.

1. The ray florets of the capitulum are carpellate and the disc florets hermaphrodite. The development of the latter takes place in the following sequence:—petals, stamens, sepals and carpels.

2. The chromonematic structure of the chromosomes is seen in the nuclei of the microspore mother cells in early prophase and also during interkinesis.

3. Chromosome conjugation is of the parasynaptic type. No irregularity was noted in the meiotic process.

4. The haploid number of chromosomes is eighteen.

5. Cytokinesis takes place by a process of furrowing.

6. A true periplasmodium is formed, the nuclei of which divide amitotically when inside the microsporangium.

7. Large multinucleated cells have been observed to be present inside the microsporangium in some anthers. Generally the nuclei of these aberrant cells show early prophasic changes while the surrounding pollen mother cells show all stages from diakinesis upwards. In a few anthers the nuclei of these large cells have been observed to divide.

8. The pollen grains are bi-nucleate. They are ellipsoidal, echinate and tetracolpate. Germ-pores are four in number and are situated in the centre of short furrows.

9. The development of the embryo-sac is of the normal type. A linear tetrad of megaspores is produced of which the chalazal one always functions. The organisation of the mature embryo-sac is of the normal eight nucleate type.

10. The number of antipodal cells varies from two to three. Normally the antipodal cells are bi-nucleate, but sometimes tri-nucleate cells also occur.

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Explanation of Plates.

All figures were drawn at table level with the help of a Zeiss camera lucida. With the exception of figure 7, the rest of the figures in plate I have been drawn at a magnification of 1,400 diameters. Figure 7 has been drawn at a magnification of 3,650. Magnification of the figures in Plate II, is given below.

Plate I.

Fig. 1.—Nucleus of microspore mother cell in early prophase. Note the beaded nature of the leptotene threads.
Fig. 2.—Zygonema stage.
Fig. 3.—Synizesis; nucleus enclosed within the meshes of the thread.
Fig. 4.—Recovery from synizesis. Double nature of the spireme evident at places.
Fig. 5.—Pachynema stage.
Fig. 6.—Diakinesis.
Fig. 7.—Polar view of metaphase, I division; note 18 bivalent chromosomes.
Fig. 8.—Heterotypic anaphase.
Fig. 9.—Interkinesis; note coiled nature of the chromosomes.
Fig. 10.—Homotypic anaphase.
Fig. 11.—Pollen tetrad surrounded by a mucilaginous pellicle.
Fig. 12.—Cytokinesis by furrowing complete. Microspores encased by the mucilaginous pellicle.
Fig. 13.—A young microspore liberated from the tetrad.

Plate II.

Fig. 14.—A longitudinal section of an anther showing a multinucleated pollen mother cell and pollen tetrads surrounded by tapetal cells, $\times 430$.
Fig. 15.—A large pollen mother cell showing the presence of eight nuclei, $\times 2140$.
Fig. 16.—Another large cell in which the nuclei are in a state of division. Seven polar groups of chromosomes are clearly seen, another group probably occurs at the position marked x; 2,140.

SOMETHING ABOUT SWORDFISH.

BY

LIEUT.-COL. R. W. BURTON, I.A. (*Retd.*)

(*With a plate*).

There is something about the taking of swordfish, and other monster fish of the sunlit tropic seas with rod and line, which has captured the fancy of the public and the big-game sea fishing fraternity; so each season many sportsmen, and sportswomen too, have been attracted to Australian and New Zealand waters.

It is an exciting sport packed with thrills, for there is always the hope that each day, each hour, each minute may bring a yet larger and more furiously fighting leviathan to test the tackle and endurance of the fisherman.

Swordfishing was begun in New Zealand waters some thirty years ago, the first of the species being captured off Cape Brett by Mr. A. D. Campbell in 1910 or 1911. In 1926 Mr. C. Alma Baker, a Vice-President and veteran Member of the Bay of Islands Swordfish and Mako Shark Club, induced Mr. Zane Grey to visit the Bay of Islands where he pitched camp at Otehei Bay on the island named Urapukapuka (meaning? Diary should say, but doesn't). On the shores of that lovely cove is now the Otehei Bay Hotel, where the visiting angler finds everything he needs for his comfort and his sport. Those wishing to be nearer the fishing grounds can obtain accommodation at Deep Water Cove which is ten minutes run, instead of an hour's, from Bird Rock: there are other places also.

Mr. White Wickham's broadbill of 675 lbs. was the record for that species up to 1928, and may be so to the present time. Names of a number of noted sportsmen are in the Club records.

New Zealand swordfish waters are off Whangaroa Heads, Cavalli Islands, Cape Brett, Mayor Island in the Bay of Plenty, and some in-between places of less note. From the available records the best period off Cape Brett is the last week of February and the first three weeks of March; this would also apply to the first two named localities. On a future visit the inclination would be to find two companions to share a launch suitable to live on a few days at a time, and so work the Cavalli area as well as Cape Brett. The cost would be less, and the sport might be more. Ordinarily the cost of this fishing is N.Z. £5 to £6 a day. (Rs. 52 to Rs. 65).

During the season 1936/37 (1st Dec. to 31st May) 28 black marlin averaged 452 lbs.; 321 striped marlin 283 lbs.; 97 mako shark 175 lbs.: the largest of the three species being 850, 404, and 612 lbs. respectively. The largest thresher shark, hammer-head shark, and king fish were 922,394, and 75 lbs.; the first named a record. Record for king fish—a redoubtable fighter, is 111 lbs.

(Zane Grey). When in Fiji the writer saw a photograph of a 112 lb. king fish, but caught nothing approaching that size in those seas during a three months stay.

Seasons vary considerably. 1937 was exceptionally good. In the following year the figures for the first three species were 9,130, and 58 only, there being much stormy weather during February and early March. Up to 9th March 1937 172 swordfish were caught off Mayor Island. Thresher and hammer-head are much less common than mako, which is a magnificent fighter.

One never knows what may come along. The late Captain Mitchell of America killed a black marlin of 985 lbs. (length 13 ft. 5 in.) off Whangaroa on the 25th February 1926. It was then a world's record. Mr. H. J. Court killed one of 957 lbs. in 1936; and in 1932 one of 823 lbs. was captured by Mrs. Eastham Guild of Tahiti. Monster fish of this species are always hoped for!

On the 8th February 1938 G.H.D. and the writer were trolling around Piercey Rock in one direction while E. E. G. and C, in Alma GII, circled the opposite way. The launches were on opposite sides when a huge black marlin, biggest launchman Arliss had ever seen, and he had been at the killing of fish of over 1000 lbs. with Zane Grey in American waters, rushed the bait from below, shot out of the water in a great curve, and went off at tremendous speed. After a hundred yards the reel overran, the line broke. Then the fish broached again—ten feet and more of him in the air—and threw the bait. Again he came up and repeated the spectacular performance in vain endeavour to get rid of the hook—then he was seen no more.

What a misfortune for G! And had the monster taken C's bait would his reel have jammed? Or D's, or mine? Who knows, Kismet. But was it just bad luck? One has to be most careful to wind the line, after wetting it, tightly on to the drum; and to brake the reel just right, neither too tight nor too loose.

That matter of luck. C. had bad luck all along, while G's was consistently good. One marlin took the bait off C's hook, then seized G's and was killed. That day 'Minerva' saw no sign of fish: while 'Valhalla', 'Alma G.II', and 'Lorna Doone' killed two each. Some sportsmen, frequently novices, do extraordinarily well; others, of much experience, will go a whole month with but one fish! Luck has it all the time: but care counts.

Broadbill are not often caught in New Zealand waters. A fine specimen taken in 1937 is mounted in the Auckland Museum; where also are exhibited specimens of marlin, mako, and other big-game fish, which should be seen.

The sword of the broadbill is as much as four feet in length, that of the striped marlin being thirty to thirty-four inches; the bill of the black marlin is shorter in proportion though the fish attains far greater size than his striped relative.

Talking of 'swords'. Before me is a photograph of the launch 'Little Jim' which was rammed off Leigh (opposite Little Barrier Island) by a striped marlin on the 29th January 1932. At the time of the attack the launch was not fishing. The sword was broken off by the frantic struggles of the great fish and is seen

to pierce the planks above the water line and protrude six inches above the deck! At Otehei Bay can be garnered authentic stories of swords broken off in bodies and heads of mako shark. The 'Minerva', seen in the photograph, bears a scar from sword of a marlin which struck a glancing blow. There must be many terrible fights when the monsters of the deep seas meet at feeding time on the immense shoals of *trevalli* and other fish which swarm in those prolific waters. Swordfish opened up have been found to contain fish of several species with spear holes in them. The prey is swallowed whole. A swordfish taking a trolled bait has been charged and transfixed by a companion fish; they often swim in pairs. One is known to have shattered his spear against Piercey Rock in his wild rush to escape. In 1937 there was a newspaper report of a terrific swordfish battle seen off Hokitika on West Coast of South Island.

No doubt the fish often die when swords are broken off, but there is a record of a piece a foot long having been left inside a rammed launch. A month later that same fish was caught (267 lbs.) his broken rostrum exactly fitting the piece in the launch. (T. E. Donne, *Rod Fishing in New Zealand Waters*, 1927). Swordfish are said to attain a speed of fifty miles an hour. That can well be believed. The caudal fins of spearfish have a greater spread than those of the true swordfish, and as the former are even more streamlined, and have two strengthening keels as supports to the waist of the tail as compared with the single keel of *Ziphias gladius*, it is likely they are the more speedy. The speed and weight of all 'swordfishes' is ample to drive their weapons through planking of any thickness found in ships and boats.

The sailfish attains a weight of nearly two hundred pounds. Not long ago a lady angler caught one of 170 lbs. off the Seychelles.

Off the coast of Chile broadbill are found in great number and are fished for commercially. One of over 800 lbs. has been taken in those waters on rod and line. (*The Field*, 21st Sept. 1935).

Fishermen, and anglers too, are sometimes injured by attacks on boats. Some have occurred on the Travancore coast. One instance was that of a fisherman wantonly attacked while sitting on his catamaran and speared through the shoulder. (*Journal* vol. xxxiii, p. 373).

When cruising at the surface striped and black marlin are distinguished by the tail fluke ripping scimitar-like through the water; broadbill show both dorsal fin and tail fluke; mako the dorsal only. Sunfish (*Orthagoriscus mola*) are sometimes seen, being known by the peculiar side movement of the big fin. Field glasses should be used. Basking Sharks (*Rhinodon typicus*), sometimes, though erroneously, called sun-fish, are of great size. One seen at Auckland in 1885 was 34 feet long with a dorsal fin of five feet in height; and one of this species stranded at Trivandrum, Travancore, in 1900 measured 29 feet with a circumference of 11 feet 3 inches.

Now let us have something from the scientists. The name 'swordfish' should, strictly speaking, be applied to the Broadbill only. Scientists divide 'swordfishes' into two families. Xiphiidae comprise one genus and species only. *Ziphias gladius*, the true

swordfish, known to sportsmen as the Broadbill. It has a flat, smooth, sword and erect backward-curved non-depressable dorsal fin. The family Istiophoridae comprises the spearfishes and sailfishes which have round, rough, bills shorter than that of the Broadbill and dorsal and ventral fins folding into recesses, thus rendering them even more stream-lined than *Z. gladius*. They also differ from *Z. gladius* in having paired pelvic fins placed beneath the body in line with the pectoral fins and also folding neatly back into a longitudinal groove. These fins are apparently in course of atrophy—a condition found in other vertebrata as instanced by the floating collar-bone of felines. It may be conjectured that by means of these the fish may know when they are touching the floor of the sea. In all species the pectoral fins fold backwards, but not into grooves.

The swords in all these 'swordfishes' are formed by the coalescence of the praemaxillae, vomer, and ethmoid bones. The roughness on the sides and under surfaces of the spearfish and sailfish bills is due to the presence of very short mediatory teeth pointing backwards.

The 'swordfish' taken off the coasts of New Zealand are mostly true spearfish, or marlinspike fishes, of two species. The Black Marlin is *Makaira mazara;* the Striped Marlin, *Makaira mitsukurii.* The Broadbill is not often taken both because of its scarcity in those waters, and because of it not readily taking a bait. The Salifish, *Istiophorus* is not apparently found in New Zealand seas. It is common in the Indian Ocean where one species of marlin is *Makaira indica* : there may be others.

Mr. V. W. Lindauer of Russell, a Life Member of the Bay of Islands Club, informed the writer that there is very little difference to mark the sexes of the marlins killed off the New Zealand coast. The more mature fish are probably females who take the bait more readily owing to developing ova; while the smaller fish may be immature males: but it may reasonably be asked whether there are any males among those caught by rod and line sportsmen. There is yet something, a good deal indeed, to be learnt about these fish.

The principal fishing ground from Bay of Islands is off Cape Brett around Piercey Island and near Bird Rock about 2 miles to the north. The first two were named by Captain Cook in November 1779 after Sir Piercey Brett, a Lord of the Admiralty. Piercey Island has a large archway through the shoreward end of it so no doubt the famous navigator had a good chuckle when he gave that name; the arch is now known as 'The Hole-in-the-Wall'.

Around these two rocks can be seen positively acres of *trevalli,* also called *cavalli* (*Caranx georgianus*) averaging four or five lbs.; seen with them is a violet-coloured fish (the *maomao, Ditrema violacea*) eight to ten inches in length. All the time there are violent upheaving splashes as the much harried fish scatter to escape the hungry under-water onslaughts of king-fish and schnappers; but not infrequently there is a rapid-running splash of a hundred yards or more, clearly indicating the furious charge of a swordfish through the lower stratum of the shoal. Somehow

one does not have much swordfish success close to these shoals, perhaps because the bait is quickly torn to pieces by smaller predatory fish.

Trevalli have small mouths and are not to be caught by any ordinary method. They are best snatched by a large treble hook thrown well into the shoal by a bait-casting rod, and afford quite good play, but time is too important to admit of any nicety in the matter. Being flat-sided fish they are excellent for trolling. The other bait used is the *kahawai* (*Arripis salar*) a salmon-shaped fish averaging five to seven lbs. and taken by any small spinner trolled with a hand-line behind the running launch. These also afford excellent sport with suitably light rod and tackle.

In my diary I find—'much time is wasted in procuring bait. The launches should be fitted with live-bait tanks under the counter: it seems foolish to waste hours of expensive launch hire, and some of the best fishing hours in the early part of the day—in searching for bait: and surely it is better to use live bait for drifting?'

The proper way to seek swordfish is no doubt by trolling, and all would fish that way during the greater part of the time were it not for the increased consumption of petrol. The smaller launches, such as 'Minerva', consume a gallon an hour—about eight miles to the gallon; larger ones considerably more. All hands need a rest occasionally and then drifting with the tide is done. That way anything—any of the four species of shark—Blue, Raremai, Tiger, Grey Nurse, may be hooked; as also Mako, Hammer-head, and Swordfish. It savours of bottom fishing for mahsir with a lump of paste! One feels with this swordfishing from a power launch that the launch kills the fish; and I agreed with D, my companion for a week, that a king fish on suitably lighter tackle affords better actual *sport*. It would be a different contest were one to fish from a row-boat, or dug-out, as is usual in some seas but could only be done on carefully chosen days in New Zealand waters; not practical politics in fact.

The question of hooks. The Bay of Islands Club did not, up to 1938, bar the use of two hooks, the practice being with some launch-men, not all, to use a treble hook as a 'dangler'. This can only be for the purpose of foul-hooking, and should not be allowed. There should be only one hook, except for sharks when two are permissible; but it is seen in the Proposed Rules for a World Big-Game Fishing Association the Rule would be:—'No multiple or 'gang' hooks may be used. Not more than two single hooks are allowed, which must be placed at least a shank's length apart'. That would seem to permit a flying hook which might foul-hook a fish. Not good! The Rule should provide for both hooks to be attached to the bait.

Now let us set out in search of the 'striped tiger of the sea', or his larger relatives. Harness is adjusted; rod placed in the socket of revolving chair; doubled portion of line fastened to wire trace by a buffer knot; No 14 hook passed firmly from below behind the lips of the bait; baited trace let out some thirty feet, the idea being to have the bait dancing on the surface, for which purpose the *trevalli* is so good; reel-brake properly adjusted; in fact every-

Photo by *Author.*

A Striped Marlin—313 lbs.

thing 'just right'. Then the 'teasers' are let out on either side, and we cruise around at five to six miles the hour all eyes on the watch for a showing fin.

This is the time for real enjoyment. The bold outlines of Cape Brett please the eye; there is the charm of watching the cloud shadows sweeping across the grassy and wooded slopes of the steep hills; of seeing the on-rushing waves ceaselessly thundering in vain fury against the perpendicular battlements of Piercey Island. The gulls scream and wheel; the great gannets steeply plunge; petrels, Mother Carey's Chickens, and other birds are seen; and there is the never-ceasing interest of the great *trevalli* shoals. The hours of waiting and expectancy may be long; the rays of the sun may be most unpleasantly hot, or the motion of the launch such as to defeat even the hardiest of sailors; but there is so much life to observe, so much movement, that there are no dull moments: while all the time there is that hopeful feeling, and not for an instant can the state of readiness be relaxed.

Marlin seem to take under most conditions, provided the water is not discoloured by storms, and will strike in calm or rough seas, on dull days and on bright days. The best hours seem to be from sunrise to mid-day and from four to six in the evening.

The 13th February was fine, the sea calm. We secured only two baits and each got a fish! Mine ran about three hundred yards before broaching in a smother of foam to stand on his tail. Failing to throw the hook he came up again several times—fighting furiously—and then bored deep, so heavy 'pumping' was necessary to prevent sounding as these fish sometimes die far below and are then very difficult to recover. Special equipment is necessary for the purpose but is not carried by all launches. After fifty minutes the fish was moving slowly to and fro some fifty yards away and in another five minutes was gaffed and quickly secured on the counter—a striped marlin of 313 lbs.

Within a few minutes we got going again and almost immediately a marlin, perhaps attracted by all the disturbance, took D's trolled bait. It was not a good fighter so was killed in 35 minutes—226 lbs. Next day D's *trevalli* was taken by a big marlin which emerged a long way off and threw the bait. Our lines were not marked at each hundred yards. It is difficult to know how much line is out and fish are missed by not striking at the right time. That has to be learned by experience and I missed two fish for that reason. As the bait was being reeled in for examination another fish seized it and gave a great display of leaping, standing on tail, skittering along the waves, a most spectacular performance. It fought all the time close to the surface. 45 minutes, 197 lbs, a striped marlin. Marlin appear to vary a good deal in fighting qualities. These two fish of the 13th are seen in the photograph of the 'Minerva'.

We hooked several sharks of the unwanted unsporting kind and cut them loose.

It was learnt in Australia that big-game fishing off the coast of New South Wales is making great progress. There are several Clubs: The Sword-fish and Tunny Club of Australia (Vic.); The

Bermagui Big-Game Angler's Club; The Illawarra Game Fish Club (N.S.W.); and further north other Clubs, including the Queensland Game Fishing Association and the Great Barrier Reef Angling Club. So the visiting sportsman has much choice of locality and can follow the coast line with the season from south to north. Off the Queensland coast boarding house accommodation can be had on several islands.

The name of Barrier Reef has a special attraction and the wonder of those prolific waters has to be seen to be realized, while the large variety of sporting fish afford never ceasing enjoyment. Perhaps the best of all is the Barred Spanish Mackerel, a leaping fighting fury running 40 to 100 lbs; it is a near relative of the well-known Seir fish of Indian seas: and there is the Queen Fish which fights almost more out of the water than in it! Others of note are bonito, albacore, kingfish, swordfish and sailfish; and one may strike a great ugly stubborn 'groper' running to seven or eight hundred pounds. The season is June to September.

As in Auckland, so in Sydney and other places all and every kind of rod, reel, line, and gear can be purchased. The *N.S.W. Official Fishing Guide and Holiday Sporting Handbook* is indispensable: in it will be found much of interest, besides many useful hints for angler and camper.

The serious Big-Game angler will know all about the Proposed World Big-Game Fishing Association, the Rules of which are to be found in the *Fishing Gazette* for the 21st and 28th January and 4th March 1939, together with interesting comments by Mr. Mitchell Henry.

'But', readers of the *Journal* may ask, 'are there no swordfish to be had nearer than the other side of the world?' Yes! Throughout the tropic seas swordfish, sawfish, spearfish, and those beautiful creatures with the lovely prussian blue dorsal fin known also as sailfish, are to be found. Wherever there are coral islands, reefs, and underwater banks all kinds of sea fish congregate, so there also are the larger fish of the deep seas which prey upon them.

Off the Seychelles, Ceylon (where is an established Sea Angler's Club providing all that is necessary for the taking of all kinds of fish), and the Andaman Islands there are swordfish and their brethren. Spearfish and Sailfish, doubtless Swordfish also, are to be found off the coast of Bombay over the Angria Bank west of Ratnagiri; the Cora Divi Bank west of Kundapoor; and the Sesostris and Bassas de Pedro Banks west of Mangalore. All these Banks being beyond the one hundred fathom line, and surrounded by deep ocean, swarm with sea fish of every description.

Adventurous Ratnagiri fishermen no doubt spread their nets and set their 'trot' lines over the Angria Bank, and it is known to the writer that the people of Chetlat and Kiltan of the Laccadives fish over the Bassas de Pedro—called by them the Munyal Par—with great success at seasons of the year when favourable weather is assured to them.

Off certain of the banks and reefs nearer to the Laccadives there are seerfish, sawfish, and every other kind of sea fish. Much

can be done by hiring a Laccadive boat of about 18 tons burthen during the months of December and January. The conditions are of course rather hard and primitive; but the sport is good and the expense not great. The fishing is out of the sailing dug-out taken along as a towed dinghy. These are the conditions for real sport as the great pelagic fish are fought on equal terms with a big-game reel of five to seven hundred yards capacity of 36 thread line. There is no room for a swivel chair. You sit on the floor of the boat with the rod butt in a stout block of wood and swivel around on the 'ischial callosities' which you soon acquire.

Indian boatmen are exceedingly happy-go-lucky so it is essential to make sure that the boats are properly fitted and found in every respect. On one occasion I had the mast come down in half a gale of wind because the stepping block was secured (!) by wire nails of insufficient length and strength. That was off Quilon, and entailed a seven mile row against wind and tide for return to the coast. One does not want such happenings in mid-ocean! And the cordage: as well to make sure it is sound, as also the sails which the west coast fishermen use to the last rotten rag. The deep sea islanders are more careful: but 'safety first' is a good slogan.

There are 'swordfish' off Cape Comorin but conditions there need a power boat. The owner of a seagoing 12 H.P. Diesel Engine Launch would have all the places mentioned at his disposal and, after the necessary exploration and experience, as good fishing as is obtainable anywhere.

Now we know something about 'swordfish'; where to seek them and how to get hitched on to these leviathans of the deep seas, as also many other worthwhile sporting fish of various kinds. All that remains is to do our individual best to aid the world to a sane existence and hope there may be tight lines for some when all the turmoil is over.

Supplementary Note.—All sportsmen interested in 'Sea Fishing in Indian Waters' should read the contributions under that title by Engineer Commander F. O. Gadsden of the R.I.M. (now the Royal Indian Navy) in volumes xii and xiii of our *Journal.* He wrote in an interesting and informative way of Bamin, Mullet and Garfish, The Andaman Seas, Karachi, and Aden.

Extremely informative articles by Major W. H. Lane as to 'Game Fish of the Persian Gulf' are contained in vols. xxiv and xxv.

A list of seafish found off the coast of Travancore is in vol. xxxiv.

The Fish Supply of Our Western Coast is exhaustively dealt with by the Editors of our *Journal* in vol. xxix, part 2, and vol. xxxiv part 4. There are many illustrations. The Authors rightly remark as to sustained supply of fish by commercial methods that 'a wide local knowledge of the life history and habits of our food fishes is essential to success': so also sea anglers should, as said by Major Lane, get a firm grasp of the habits and nature of the particular fish in quest; determine the method which will present the lure in the most natural way; ascertain what pattern

of lure is most deadly; select the most suitable locality': to which sound advice may be added the necessity of knowledge of the season—the precise month—during which the various species sought are to be found in suitable localities.

Only by reading and studying all the above-cited articles will the sea angler arrive at that success which he would otherwise only attain at long last through expensive and vexatious experience.

All Fresh Water Anglers in India will be interested and widely informed by the illustrated article 'Game Fishes of Bombay, the Deccan, and the Neighbouring Districts of the Bombay Presidency' contributed by Sir Reginald Spence and Mr. S. H. Prater and published in part I of vol. xxxvi. The article by Mr. A. Macdonald in vol. xxxiii part 2 on the Mahsir of the Irrawaddy Confluence above Myitkyina should not be overlooked.

If any Member wishes to try 'Fishing without a Fish Hook' and so catch fish in running streams in the most sporting manner imaginable, he should read Miscellaneous Note xix at page 789 of vol. xxii and marvel at the ingenuity of the untutored human of the wilds.

R. W. B.

Editors' Note.—Back numbers of the *Journal* referred to above are available at a cost varying from Rs. 3 to Rs. 5 per copy.

In connection with the study of fishes the Editors invite attention to the illustrated series, *The Game Fishes of India,* now appearing in the *Journal* with the permission of the Director, Zoological Survey of India. The author of this series is Dr. Sunder Lal Hora to whom has been entrusted the preparation of the second edition of Dr. Day's *Fishes in the Fauna of India* Series. It is anticipated that this second edition will extend to at least five volumes. The first edition was of two volumes and published in 1889.

By a curious coincidence we received Colonel Burton's article on the same day that a copy of Memoirs of the Royal Asiatic Society of Bengal, vol. xii No. 2, pp. 215 to 315 came to us from Calcutta. In that issue of the Memoirs is an article by Mr. E. W. Gudger, Honorary Associate in Ichthyology, American Museum of Natural History, New York, entitled 'The Alleged Pugnacity of the Swordfish and the Spearfishes as shown by their Attacks on Vessels'. All specially interested in this subject would be very fully informed by perusal of this comprehensive and well illustrated contribution to science. The cost of it is Rs. 7/14.

NOTES ON SOME NEW AND INTERESTING BUTTERFLIES CHIEFLY FROM BURMA.

BY

MAJOR-GENERAL SIR HARRY TYTLER, K.C.B., C.M.G., C.I.E., D.S.O.

PART II.

[Owing to the death of the author, the manuscript of this part has been edited by Mr. G. Talbot, F.R.E.S., who has also corrected the proofs of both parts.—*Ed.*].

NYMPHALIDÆ.

Charaxes fabius nagaensis, s.sp. nov.

Male: differs from the typical form before me from Chota Nagpore, and the United Provinces, in being larger, and in having the yellow macular band narrower and spots smaller; it is as large as the Ceylon form *Ch. fabius cerynthus,* Fruh. but the yellow macular band is paler; it differs from *Ch. fabius sulphureus,* Rothsch. in being larger, with the macular band darker.

A large series of males was taken at Nichuguard at the foot of the Naga Hills; a female was taken in the Lushai Hills.

Further south-west, in the Chin Hills, a male of *Ch. fabius sulphureus,* Rothsch. was taken. I have not taken the latter farther north than Bhamo; it occurs more commonly further south in S. Shan States and in the Karen Hills.

♂ and ♀ paratypes are deposited in the British Museum.

Eriboea narcaea thawgawa, s.sp. nov.

This form is very close to *E. lissainei,* Tytl. from the Naga Hills, and to *E. aborica,* Evans. In size it is equal to the latter. On the *upperside* it agrees with *aborica,* Evans in having on the forewing the dark submarginal band as broad, but the pale spots are much larger. On the hindwing it differs in lacking the pale line in the middle of the post-discal black band from the tornus to v. 4. On the forewing the submarginal spots have rounded apices, in interspaces 1, 2 and 3, instead of being pointed.

From *E. lissainei,* Tytl., it differs on the *upperside* in the black border to the forewing being broader, and the pale spots rather larger. On the hindwing there is no trace of the pale brown edging to the discal band which shows through from the underside. It is not rare, and a large series of males was taken at Htawgaw at the end of June.

A ♂ paratype is deposited in the British Museum.

Eriboea eudamippus nigrobasalis, Lathy.

Brig. Evans, in his 'List of Indian Butterflies,' gives the range of *E. e. eudamippus,* Doubl. as Kumaon-Assam; of *E. e. nigrobasalis,* Lathy as N. Burma; and of *E. e. jamblichus,* Fruhst. as Karens—S. Burma.

The type of *E. e. nigrobasalis,* Lathy came from Pak-a-jong, Siam. I have not seen the original description nor have I seen the type, but according to Lord Rothschild and Dr. K. Jordan, (*Novitates Zoologicae,* vol. vi, 1899, pp. 266-267), the type has the cell of forewing all black and the abdomen above *pale yellow.*

Lord Rothschild and Dr. Jordan include specimens from the Shan States in this subspecies, but at the same time note that these specimens have *black* bodies and state 'It appears singular that in the specimens from Pak-a-jong *the abdomen is pale yellow* as in *E. eudamippus*'.

I have a fairly large series of *E. eudamippus* before me and note the following differences amongst the geographical forms :—

Specimens as far east as Assam, Naga Hills and Manipur, and at Sadon, extreme N.-E. Burma, are the same as those from Sikkim, i.e. typical *E. e. eudamippus*, Doubl.

At Htawgaw, which is considerably to the south of Sadon, a *large* form occurs with cell and base of forewing entirely black, and base of hindwing yellow; the marginal area of hindwing is not clear yellow but dusted with dusky bluish. Two males were taken in June (wet season). I propose calling this form **splendens**, s.sp. nov.

Further south, at Maymyo, N. Shan States, a slightly different form occurs; two specimens taken in June and September (wet season) are very much smaller, and in addition to having the cell and base of forewing black, the base of the hindwing is also black. Two specimens taken at the same place, one in February (dry season) and the other undated, but probably a dry season form, are slightly larger; the body and cell of forewing are black, but the cell has a small pale diffuse spot in it, and the base of both wings is only slightly dusted with black. The marginal area of hindwing is clearer yellow than the above form *splendens*, Tyt.

From further south and east I have received two specimens from Loimwe close to the Siam border, taken in July (wet season), which are very similar to the form from Maymyo with cell and base of forewing entirely black, and with a slight dusting of black on base of hindwing. Still further south, of ten males and one female from the Karen Hills, two have the cell and base of forewing entirely black, and the remainder have the cell black with a large whitish suffused patch against the lower edge of the cell; these have the base of the forewing only slightly dusted with black, and one male and the female have no dusting of black at all. The abdomen of all these is *greyish yellow*, in only one is it *pure yellow*. The late Mr. G. E. R. Cooper informed me that still further south, in the Dawna Range, in the dry season; he has taken both *black-bodied* forms and *greyish yellow-bodied* forms but at different elevations.

It would appear that the Karen Hills form is very close to *Eriboea e. nigrobasalis*, Lathy, but without seeing the type I am unable to say whether they are identical or not; but the black-bodied forms from Maymyo and Loimwe are certainly not *nigrobasalis*, Lathy and will require a new name. I propose the name **chota**, s.sp. nov. for this form. Type ♂, Maymyo.

Eriboea eudamippus jamblichus, Fruhst.

The type is given as from Tenasserim, but without further precise locality; Fruhstorfer, in his description, states :—

'Males from Tenasserim in my collection are smaller than males of the dry season period from Sikkim, and do not show any blue bordering at all on the proximal part of the submarginal catenary band of the hindwings which is copiously provided with very large pupils.'

I have seen no Karen Hills nor Dawna Range specimens which agree with this description, but I have seen specimens from Tavoy and Mergui, in the late Mr. G. E. R. Cooper's collection, which do agree, and it seems probable that *E. e. jamblichus* only occurs in the extreme south of Burma.

Apatura cooperi, Tytler.

There are two broods of this insect; the spring brood, flying in May and June, and the autumn brood, in October and November. The latter seasonal form is the more plentiful.

The two forms do not differ.

Apatura ulupi kalawrica, Tytler.

There are two broods of this form; the spring form, flying in May and June, and the autumn form, in September and October.

A male taken at Maymyo is a melanic aberration with the yellow markings dusted with black.

Apatura ulupi mai, s.sp. nov.

A single male taken at Loimwe, S. Shan States, differs from *Ap. ulupi florenciae,* Tytl. as follows :—

Upperside : darker brown and not so tawny. Forewing with all the yellow markings smaller and more round. Hindwing with all the yellow markings very small and indistinct ; a well defined row of macular terminal yellow spots as in *Ap. u. florenciae,* Tytl. but darker ; the subterminal row of blackish spots obsolescent and very indistinct. Apex of forewing and tornus of hindwing much blunter and not nearly so much produced. The differences are well marked and although only a single male was taken, I consider it is a good local race. Its occurrence at Loimwe extends the range of the collective species a considerable way to the east. It appears to be very rare.

Apatura parvata burmana, s.sp. nov.

Male : Larger than *Ap. parvata,* M., from Bhutan and the Naga Hills, of which I have a large series before me.

Upperside : darker, with yellow markings more distinct ; the band on the hindwing much broader and better defined.

Underside : darker, all black markings more defined ; discal band broader as on upperside.

Hindwing : tornus more produced.

Six males were taken at Htawgaw and Sadon, N.-E. Burma, from June to September.

A ♂ paratype is deposited in the British Museum.

Euripus halitherses, Doubl.

Brig. Evans gives four forms of females, namely :—

♀ *v. isa,* M. as typical form ; outer half upper hindwing brown.

♀ *v. nyctitius,* Db. Upper forewing dark brown with apex broadly suffused bluish. Upper hindwing all dark brown.

♀ *v. cinnamoneus,* W.-M. As last, but upper hindwing outwardly with white streaks.

♀ *v. alcathaeoides,* de N. As *nyctitius* but upper forewing all dark brown.

In the large series of females before me I notice the following subdivisions :—

♀ *f. isa,* M. *1st form* : typical. *2nd form* : hindwing very white, almost extending over the whole wing. *3rd form* : as 2nd form, but darker and white area, which extends to termen, well-defined with brown streaks along the veins.

♀ *f. cinnamoneus,* W.-M. *1st form* : white streaks on hindwing restricted to the terminal area. *2nd form* : white streaks more extensive, and produced inwardly to the discal area. *3rd form* : as in 2nd form but apex of forewing suffused with violet.

Penthema lisarda, Doubleday.

Fruhstorfer gives the range of this species as Sikkim to Assam, and that of the form *T. mihintala,* Fruhst. as the Chin Hills.

Brig. Evans extends the range of the species to Manipur, probably based on specimens taken by myself, 1911-1914.

Fruhstorfer separated the form from the Chin Hills as being larger than Sikkim forms, the colour of the underside being dull brown and not red brown, and the spots in the cell being rounder and the internervular strigae broader.

I have a large series of forms taken in the Abor Hills, foot of the Lushai Hills bordering on Cachar, Manipur and N.-E. Burma ; also one male from the Arrakan Hills which agrees with Fruhstorfer's description of his *mihintala.*

All the other forms are intermediate in varying degrees between typical *lisarda,* Db. and *mihintala,* Fruh., those from the foot of the Lushai Hills being closer to *lisarda,* and those from Manipur and N.-E. Burma being closer to *mihintala.*

I have only one specimen before me from the Arrakan Hill tracts but have seen several in Mr. Cooper's collection ; he kindly gave me the specimen referred to ; this form is constant in the shade of colouring on the underside.

The occurrence of the collective species to N.-E. Burma extends its range considerably to the east.

Penthema darlisa, Moore.

The type came from the Thounguen forests in Upper Tenasserim.

Further North, in the Karen Hills and at Maymyo, Northern Shan States, a modified form occurs which appears to be constant. It differs in the following respects :—

Male and female. *Upperside*. Forewing with a long bluish-white streak in interspace 1, not broken into two spots as is generally the case in the typical form. *Hindwing* with discal row of spots not touching the internal streaks except in interspace 2; a round detached spot placed inwards to the discal spot in interspace 6, in the typical form replaced by a discal streak touching the outer spot.

Underside. As on upperside but discal spots on hindwing very small.

I propose the name **shania**, s.sp. nov. for this form.

To the south, in Tavoy, a very large and distinct form occurs.

Male and female. *Upperside* with all white markings large. Forewing with a long streak in interspace 1. *Hindwing* with discal streaks broad, and coalescing with the discal spots, forming one uninterrupted streak. *Underside*, as upperside except that some of the discal spots in 4, 5, 6 and 7 are sometimes clear of the discal streaks.

I propose the name of **cooperi**, s.sp. nov. for this race.

The late Mr. G. E. R. Cooper found this form as Kanbank, Tavoy, and kindly gave me a pair.

Penthema binghami, W.-M.

The late Mr. G. E. R. Cooper, in his large series, had several interesting forms of *binghami*, some of which were intermediate between the various named forms :—

(*a*) *The typical* form from Dawnas with small spots on fore and hindwings.

(*b*) *P. binghami merguia*, Evans, from Ataran Valley, with spots on forewing small and discal streaks on hindwing joined to terminal spots.

(*c*) An intermediate form, from Hangatharaw, in which the spots on forewing are the same as (*b*) but much larger than in (*a*); the two discal streaks near the tornus are joined to the submarginal spots.

Euthalia flora cooperi, s.sp. nov.

Specimens of *E. flora*, Butl., taken by the late Mr. Cooper in the Ataran Valley, have the borders on the upperside pinkish-violet and not blue, and are very close to the form of *salangana*, Fruh. which occurs on the Western Coast of Siam opposite the Nicobars, the only difference being that the border is not so broad. Typical *E. flora andersoni*, M. has a blue border, and occurs further south.

It is better to consider *E. andersoni* as a race of *E. flora*, Butl. than of *E. lepidea*, M.

Euthalia julii anisakani, s.sp. nov.

Male: Wet season form very like *Eu. julii xiphiones*, Butl. on the upperside, but on the underside the two discal rows on forewing are rather farther apart, and the inner spot in 4 is not so bent outwards and out of line.

The dry season form is much smaller and paler. Female. *Upperside* rather similar to *E. julii adima*, M. female. *Underside* very similar to the female of *E. julii xiphiones*, but as in the male the two brown discal lines are rather further apart, and the inner spot in 4 not so outwardly thrown out of line and so placed further from the outer spot.

A male and female of the autumn form, taken in December, is as large and dark as the w.s.f., but all the markings on the underside are obliterated.

Types: male and female, Anisakan, N. Shan States. Several specimens were also taken in Maymyo.

Euthalia kesava maymyoensis, s.sp. nov.

Types: Male and female. Maymyo, N. Shan States.

Brig. Evans gives the habitat of *E. kesava kesava*, M. as Assam—N. Burma and of *E. kesava discispilota*, M. as Bhamo—S. Burma. Besides males before

me I have a female from Bhamo and one from the Upper Chindwin which are certainly not *discispilota*, M.; the female is quite different.

The male is similar to *E. kesava kesava*, M. and to *E. kesava discispilota*, M.

Female. Much smaller than the former and slightly so than the latter. It is nearer to *E. kesava kesava*, M. than to *E. kesava discispilota*, M., but differs from the former as follows:—

On the *upperside* both wings with discal grey area extending well over the submarginal line; submarginal line not so crenulate.

Underside: submarginal line as on upperside. The specimen taken on the Upper Chindwin is not typical but nearer to this form than to *E. kesava kesava*, M. Specimens of the ♀ taken at Sadon, N.-E. Burma, are typical *E. kesava kesava*, M.

Euthalia eriphylae, de Nicév.

There has been a good deal of confusion regarding de Nicéville's insect.

Bingham placed it under *Euthalia apicalis*, Voll., and Brig. Evans considered it to be a race of *Eu. merta* M.

E. eriphylæ de N., according to Fruhstorfer, was based by de Nicéville on males of two different species, namely true *Eu. eriphylæ* de N., figured by de Nicéville himself, and *on E. apicalis*, Voll., or rather on *Eu. merta*, M., the Tenasserim form of *apicalis*, Voll.

According to Bingham de Nicéville described and figured the female of *Eu. eriphylæ*, erroneously as *Eu. binghami*, de N. This statement I do not consider to be correct as de Nicéville's fig. of *Eu. binghami* does not agree with a large series of females of *Eu. delmana*, Swinh., the Assam form of *Eu. eriphylae*, de N. (the Burma form) and which are undoubtedly the females of that species.

The females of *Eu. eriphylæ delmana*, Swinh. can easily be recognised by the shape of the submarginal dark band on the upperside of the forewing; this band is *not* parallel to the termen but inwardly bent in the middle in the same way as it is in the male. de Nicéville's fig. of the male clearly shows the shape of this band.

So de Nicéville's figure and determination of the female of his *binghami* must be assumed to be correct until proved to the contrary.

Eu. merta, M. is a distinct species and has nothing to do with *Eu. eriphylæ*, de N.

The males of *Eu. eriphylæ*, de N., dry season form, differ from the dry season form of *Eu. delmana*, Swinh. in having the apex of the forewing and tornus of the hindwing more pointed. The *upperside* is not so dark and all the pale markings are still paler, especially along the termen of both wings. The pale terminal area of the hindwing has a series of detached dark spots, whereas in *delmana* these spots coalesce and form a continuous dark brown band. *Underside* darker, otherwise the same.

Female. The single d.s.f. ♀ of *Eu. eriphylæ*, de N. in the British Museum, taken at Pattechaung in the Karen Hills in March 1926, and kindly sent to me on loan for examination, differs considerably from the d.s. forms of *delmana* now before me from the Naga Hills.

Upperside. Much paler; the white sub-apical markings of forewing nearly pure white instead of being sullied or pale brown; submarginal band on hindwing slightly paler on its inner edge, and inwardly the crescents are more pointed.

Underside very pale; the bluish suffusion which almost covers the hindwing is carried into the base of the forewing and into the cell. In *delmana* this bluish suffusion is confined to the lower half of the hindwing and does not extend to the forewing except slightly into the cell.

The wet season males of *delmana* are darker above than the dry season forms, and all the dark markings below are more prominent.

The wet season females are much darker above; the underside is also darker and the bluish suffusion is more vivid.

In the British Museum there is a fair series of dry season males and one female of true *E. eriphylæ*, de N., from Lower Burma, and two males and one female of *Eu. delmana*, Swinh., including ♂ and ♀ types from the Khasi Hills.

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Of *Eu. delmana*, Swinh., there are before me, in my collection, four males and five females of the wet season form and thirteen males and six females of the dry season form. It is very rare in the Naga Hills and apparently also rare in the Khasi Hills.

Eu. eriphylæ, de N., also appears to be very rare in Lower Burma.

Two males and a female from the Naga Hills have been deposited in the British Museum.

Euthalia duda amplifascia, s.sp. nov.

Male : *Upperside* with white discal band on both wings very much broader than in the typical form, as broad as in *D. durga.* Forewing with discal band continuous and not macular as in *D. duda*, Stgr. *Underside* with ground-colour and all markings darker.

The type was taken at Sadon, N.-E. Burma, at about 6,000 ft., in July.

Euthalia durga splendens, Tytler.

Two specimens of this very rare form were taken at Sadon, N.-E. Burma, in July, at about 6,000 ft.

Euthalia nara, Moore.

Moore's type was described from Sikkim; the collective species extends over a large area and is represented by local forms as far East and South as the Shan States, Burma.

Evans, in his *Ident. Ind. Butt.*, has separated the form from Loimwe, S. Shan States, under the name *shania*, based on the colour of the male which he describes as bright dark green instead of bronze olive-green as in Sikkim males. He does not mention the female.

The males of the various local races are hard to describe in writing but can readily be seen when series of each form are placed side by side. The females, however, are different, and easily distinguishable.

I propose separating the form from the Naga Hills and Manipur and also the form from Kalaw in the northern portion of the S. Shan States. A single male from N.-E. Burma is again different, but until the female is found and a larger series of males obtained, it had better be placed with the Naga Hill form.

Euthalia nara nagaensis, s.sp. nov.

Male : *Upperside* darker bronzy green than Sikkim males, with all dark markings more conspicuous. Female : *Upperside* very bronzy, much more so than in Sikkim females. Forewing with discal white band narrower, especially in interspace 2, where it is very small. Hindwing with the two costal white spots obsolescent and blurred, not white and clear as in the typical form. *Habitat* :—Naga Hills and Manipur.

Euthalia nara kalawrica, s.sp. nov.

Male : *Upperside* with all dark markings more conspicuous than in the Sikkim form. Hindwing with the apical yellow patch smaller, with the discal green area dividing it in two and reaching the costa. Female : *Upperside* brighter green and dark markings more distinct, as in male. Forewing with the discal transverse white band much broader, except in interspace 2, where it is much smaller. *Habitat* :—Kalaw, northern portion of the S. Shan States.

Euthalia nara shania, Evans.

Type, Loimwe, S. Shan States.

As Evans' description, in his *Ident. Ind. Butt.*, is rather scanty, and only refers to the male, I am giving a fuller description based on a large series of both sexes.

Male. *Upperside*, as stated by Evans, brighter green. All dark markings more conspicuous than in the typical form. Hindwing with discal yellow area larger, the green discal colour just entering interspace 6.

Female. *Upperside* rather darker than the Sikkim form, with all dark markings more conspicuous. Forewing with the white discal band similar, but the spot in 2 much smaller. Hindwing with the two costal white spots, in 6 and 7, completely absent or only one minute spot in interspace 6 sometimes present.

Males are common; the females very rare.

Euthalia narayana, Gr.-Sm.

The type, a ♀, was taken in the Ruby Mines, in the Bhamo Hills.

It also occurs commonly in the Naga Hills, rarely in Manipur, rarely in the extreme N.-E. of Burma; side by side with races of *E. sahadeva,* M. it also occurs throughout the S. Shan States.

At Loimwe, in the extreme S.-E. of the S. Shan States, it occurs commonly with *E. sahadeva* which, however, is very rare.

There has been some confusion about this form, and it has been considered by some authors to be a race of *E. sahadeva,* M. As the two forms occur together over a great part of their range I think it better to give *E. narayana,* Gr-Sm. specific rank.

This form is represented in my collection by 13♂♂ and 14 ♀♀ from the Naga Hills; 1 ♂ and 2 ♀♀ from Manipur; a pair from extreme N.-E. Burma; 5 ♂♂ and 4 ♀♀ from Maymyo, N. Shan States; 6 ♂♂ and 3 ♀♀ from the Kengtung State, extreme east of the S. Shan States. It is curious that both *sahadeva nadaka* and *narayana,* which occur commonly side by side in the Naga Hills, are rare in the adjoining Hills of Manipur.

Euthalia sahadeva, Moore.

The following notes are tentative and are based on 30 ♂♂ and 35 ♀♀ in my collection and now before me.

The collective species has been divided up into three subspecies:—

E. sahadeva sahadeva, M.		type, ? Bhutan; Sikkim.
E. ,,	*nadaka,* Fruh.,	type, Khasi Hills.
E. ,,	*narayana* Gr.-Sm.,	type ♀, Ruby Mines, N. Burma.

There is no difficulty in recognising the Sikkim-Bhutan form, *E. sahadeva sahadeva,* M., in which the males have all the markings large and yellowish-white, and on the hindwing the post-discal series of six spots extending to interspace 2. The female is much larger than the male; upperside dark bronzy-green; discal band on forewing white, and hindwing with one subcostal white spot in 6.

There should also be no difficulty in recognising *E. sahadeva nadaka,* Fruh., from the Khasi Hills, which Fruhstorfer describes as ♂, on both sides darker leaf-green than specimens from further west; hindwing with *three,* instead of *six,* white discal spots.

Female, as figured by Moore, with no white spots on hindwing.

I have no males before me from the Khasi Hills, and only two females: these differ from Moore's fig. in one having one small white subcostal spot in 6 on upper hindwing and the other having three spots in 5, 6 and 7; otherwise similar to the female from Sikkim.

This form extends into the Naga Hills and Manipur where it differs slightly in the male having very occasionally one or two additional discal spots below the upper three; in the female the number of spots on the hindwing may be one or two, or they are entirely obsolescent.

Of this form there are before me 27 ♂♂ and 9 ♀♀ from the Naga Hills, and one male from Manipur.

Euthalia sahadeva thawgawa, s.sp. nov.

A third form of *sahadeva,* which I propose calling as above, occurs at Hthawgaw, N.-E. Burma. Both sexes are darker than the Naga Hills specimens, and the female is brighter green; the male has five discal spots on hindwing instead of three; the female has none.

There are also before me two females from the extreme S.-E. end of the S. Shan States; these agree with the females from Hthawgaw, but without seeing a male it is not certain whether they are the same or not. It is curious that I have received no specimens from intermediate areas, but they probably occur.

Euthalia lengba, s.sp. nov.

In the *J. B. Nat. Hist. Soc.*, Feb. 2nd, 1915, I recorded the capture of this species, in Manipur, erroneously under the name of *E. taooana,* M., which is, however, quite different.

Male. Smaller than *E. taooana,* M.

Upperside rather more yellowish, markings very similar, but discal band on forewing not so broad and spots narrower; spot in 3 not touching spot in 4. Hindwing with three post-discal spots, and one or two black white-centred spots in 3 and 4; the outer edge of these spots *convex. Underside* more greenish-yellow than *E. taooana;* marking very similar. In appearance it is between *E. taooana,* M., and the form of *confucius* described below.

Euthalia confucius sadona, s.sp. nov.

Male: very like *E. lengba,* Tytl., but upperside much darker green. *Upperside.* Forewing with post-discal band darker yellow; spot in 4 projecting outwards beyond spots on either side. Hindwing with three discal spots in 5, 6 and 7; no traces of spots below; spots in 5 and 6 excavated on the inner edges.

Underside. Forewing with conspicuous black subterminal band bordering the subcostal spots and reaching spot 2; inner edge of all the spots in the post-discal band edged with black; a large black area below the white spot in 2, with two small white dots in the middle. It differs from *E. confucius,* Leech, in being much smaller, with more pointed wings; the colour is much darker green on the upperside; the post-discal band on forewing is much narrower; no spot in 1. Hindwing with three post-discal apical spots.

Type ♂ from Sadon, N.-E. Burma, 16-7-1929, deposited in the British Museum. Also a male from Hthawgaw, N. Burma, 27-7-1927, in my collection.

Limenitis austenia purpurascens, Tytl.

This form occurs in N.-E. Burma as a variety of *L. austenia austenia,* M.; of four males secured, three are very close to typical *austenia,* M., and one is identical with typical *purpurascens,* Tyt., with the rosy purple colour very conspicuous.

Limenitis brunnea, s.sp. nov.

Male. *Upperside* dark brown, with paler brown discal and subterminal bands *parallel* to the outer margin; edges of the bands even. Forewing with a white apical spot as in *L. danava,* M. *Underside* very similar to *L. danava,* M., but darker; the outer edge of the subterminal band on hindwing even and not crenulate. Two males were taken at Konglu and Hthawgaw, N.-E. Burma. It appears to be very rare. A paratype has been deposited in the British Museum. There also are four males from Lingtsi, Bhutan, 6,500-7,500 feet, and one from the Mishmi Hills, 4,000 feet.

Limenitis zayla, Doubl.

A single male was taken at Hthawgaw N.-E. Burma. I believe this species has not been recorded from Burma.

Limenitis oberthüri rileyi, s.sp. nov.

Male. *Upperside* very similar to *Hestina oberthüri,* Leech, from W. China but all the pale grey streaks between the veins broader. *Underside* ground colour reddish-brown and not grey-brown as in *oberthüri,* Leech. Forewing

with grey markings broader as on upperside and dusted over with darker grey. Hindwing with grey markings dusted with reddish-brown, broader in the cell and in 5, 6 and 7, getting very indistinct towards the tornus where the reddish-brown colour is superimposed.

I have much pleasure in naming this species after Capt. Riley who has afforded me the greatest assistance in working out my new form from Burma. Four males were taken at Hthawgaw, N.-E. Burma, in June. A male paratype is deposited in the British Museum.

Pantoporia sulpitia adamsoni, Moore.

This butterfly has, I believe, only been recorded from N. Burma, and I have taken it from Putao N.-E. Burma to Maymyo N. Shan States. I have also taken one ♂ at Pattechaung, Karen Hills. This extends its range a good deal further south. It must be very rare in the Karen Hills as Pattechaung has been systematically worked by numerous collectors.

Pantoporia zeroca whitei, s.sp. nov.

A single male taken at Fort White, Chin Hills, differs considerably from typical specimens from the Naga Hills and Manipur.

Upperside. Both wings with pale bands broader and broadly edged with greyish-blue. *Underside.* Forewing: the two apical spots are very narrow; the pale band in the cell has below it three dark vertical lines connecting this area with the lower edge of the cell. Hindwing post-discal band very narrow.

It is a very beautiful and distinct looking insect.

Pantoporia opalina shan, s.sp. nov.

Male and female differ from *P. opalina orientalis,* El., from the Khasi and Naga Hills, in being smaller; the markings on the upperside are pure white and not sullied; the white spot beyond the apex of cell of forewing, blunt and short, not long and narrow and pointed. On the underside the terminal and dorsal area of the hindwing not washed with violet as in *P. orientalis* and *P. opalina opalina,* Koll., from the N.-W. Himalayas.

It occurs commonly in the Northern and Southern Shan States.

Types, male and female from Maymyo. From the extreme N.-E. Burma there is before me a male which agrees with true *P. orientalis,* El., from the Naga Hills and Assam. ♂ ♀ paratypes are deposited in the British Museum.

Pantoporia punctata, Leech.

Four males of this species were taken in Hthawgaw, N.-E. Burma, in June. They only differ from Leech's figure in having the discal patch on the hindwing much larger.

This is an interesting capture as it has not been recorded within Burmese limits before.

Pantoporia jina jinoides, Moore.

A large series was obtained at Sadon N.-E. Burma. Some of the specimens were hardly separable from *P. jina,* M.

Neptis sankara guiltoides, s.sp. nov.

Male and female differ from *N. guilta,* Swinh., in having all the bands on the upperside purer white and not sullied with brown; the markings on the underside are broader, especially the submarginal pale band of the hindwing.

Numerous specimens of both seasonal forms were taken at Maymyo, N. Shan States; and also in the Karen Hills. Two females taken in August and October differ from others taken in October in the pale markings on the upperside being tinged with yellow, as is sometimes the case with *N. sankara guilta,* Swinh.

A curious aberration taken by Dr. Haynes, and kindly presented to me, is *very pale* sepia-brown on both upper and lower surfaces.

Specimens taken at Sadon, in the extreme N.-E. of Burma, are not typical but intermediate between this form and *guilta*, Swinh.

Paratypes ♂ and ♀, and the aberration noted above, have been deposited in the British Museum.

Neptis cartica cartica, Moore.

The range given for this insect by Brig. Evans in his *Ident. Ind. Butterflies* (2nd Ed.) is 'Sikkim-Assam' and of *N. cartica burmana*, de N., 'Assam-Burma'. I have a large series of both forms before me and find that no specimen of *burmana* has been taken further north than the Karen Hills; whereas the form occurring commonly from Manipur, through the Naga Hills, and N.-E. Burma to the S. Shan States is *N. cartica cartica*, M. *N. cartica burmana*, de N. does not appear to be so common as *N. cartica cartica*, M.

Neptis ananta learmondi, s.sp. nov.

Male. *Upperside* differs from *N. ananta ochracea*, Ev., in having all the yellow markings larger and of a brighter and lighter colour.

Underside. Forewing somewhat similar. *Hindwing* with discal band broader, and on its inner edge margined with blue from the dorsal margin to v. 5; the violet post-discal band is narrower, and the subterminal violet band is much broader.

Female. *Upperside* rich clear yellow; darker than the female of *ochracea*, Ev.; subterminal band very broad; somewhat similar in colour to the female of *N. ananta namba*, Tytl., but the subterminal yellow band broader.

Underside very similar to *N. ananta namba*, Tytl., but the subterminal band on hindwing much broader.

Fifteen males and a female were obtained at Loimwe, S. Shan States, by Capt. Learmond after whom I have much pleasure in naming this form.

Neptis ananta namba, Tytl.

A large series was obtained on the Putao Road, N.-E. Burma, in March.

Neptis melba gafuri, s.sp. nov.

In the *Journ. Bomb. Nat. Hist. Soc.*, 1915, p. 508, I erroneously recorded this form from the Naga Hills as *N. antilope*, Leech. I recorded how it differed from Leech's insect, and stated that in view of those differences it might prove to be a race of that species. It is very close to *N. melba*, Evans, and is undoubtedly a race of that form, from which it only differs in the *upperside* being yellow instead of white. The *underside* also differs in being yellow instead of whitish. The female is very similar to the male.

Neptis melba pila, s.sp. nov.

This form is very like *N. melba melba*, Ev., but the colour on the *upperside* is pale yellow and not white. It differs on the *upperside* from *N. melba gafuri*, Tytl., in the yellow colour being much paler; on the hindwing the post-discal yellow band broader. The *underside* is very similar to *N. melba melba*, Ev., but the colour is very pale yellowish.

Five males and two females were obtained at Loimwe, S. Shan States, in April, September, and December. A female was also taken in Bhamo in May. I think it better to consider *N. melba*, Ev., as a distinct species and not as a sub-species of *N. antilope*, Leech, to which insect it is very different in appearance.

♂ ♀ paratypes are deposited in the B. M.

Neptis aspasia, Leech.

A single ♂ was taken at Hthawgaw, N.-E. Burma, in July.

Neptis radha asterastilis, Oberthür.

The type in the Oberthür Collection came from Momeit, N. Shan States. It may be a dry season form. All the specimens I have seen from Burma, except two in the British Museum which agree with the type, are typical *radha,* M. Oberthür's fig. unfortunately accentuates the paleness and makes the ground-colour pale yellow, almost white in places, which is not the case in the type.

I have before me three ♂♂ from N.-E. Burma which are typical *N. radha,* M., and one ♂ from Bhamo, N. Shan States, and close to where the type came from; this is slightly paler on the upperside and may be considered to be *asterastilis,* Obrth.

Neptis zaida thawgawa, s.sp. nov.

Male. *Upperside* somewhat similar to *N. zaida drummondi,* Tyt., but the apical and submarginal spots on forewing are larger. Hindwing with discal band broader, and the submarginal band narrower. *Underside* markings somewhat similar to *N. zaida manipurensis,* Tytl., but the ground-colour is greenish-yellowish tinged with rufous. A single male was taken at Hthawgaw, N.-E. Burma, between 5,000 feet and 8,000 feet, in June.

Neptis beroë, Leech.

A single male was taken ot Loimwe, S. Shan States, in April 1928.

This is an interesting capture as this Chinese insect has not previously been recorded from Burma.

Doleschallia bisaltide kara, s.sp. nov.

Male. Rainy season form differs from *D. andamanensis,* Fruh., on the *upperside* in being rather darker; interspaces 2 and 3 in the forewing are concolorous with the rest of the wing and not paler as in that form; the black terminal area darker, extending as far as the tornus; the fulvous bar across the apex narrower and more diffuse, especially the portion in 4 and 5; four subapical white spots instead of three. Hindwing terminal area with two very distinct marginal lines, and two discal black spots large and more distinct.

Underside very dark, and all markings very prominent.

Dry season male above as in the wet season form; below very dark but markings not very prominent.

Female. The dry season form does not differ very much from the Andaman form, types form Car Nicobar, except that the underside is uniform light fulvous.

Vanessa cardui aureum, Linn.

A female was obtained on 16th December, 1924, at Loimwe, close to the Yunnan and Siam borders. It agrees entirely with specimens in the British Museum. It has not previously been recorded from Burma. Brig. Evans probably referred to this specimen in his '*Identification of Indian Butterflies.*'

Vanessa urticae chinensis, Leech.

Three males were taken at Hthawgaw in July. This is an interesting capture as it has not been previously recorded from Burma.

Araschnia prorsoides dohertyi, Moore.

A large series was obtained at Hthawgaw, N.-E. Burma, during July-October.

Symbrenthia brabira doni, s.sp. nov.

Male and female. *Upperside* with fulvous markings slightly broader. Specimens taken in May and June (dry season) are very like *S. brabira,* M., taken in June and August. *Underside* very similar, but the ground-colour

is not uniformly yellow and has some paler patches; the black markings are slightly heavier; the post-discal band has no blue centres on the yellow ground.

The wet season form, taken in August, is larger and darker, with narrower fulvous markings, otherwise similar. Types from the Naga Hills. It also occurs at Hthawgaw, N.-E. Burma.

Argynnis laodice indroides, s.sp. nov.

The form occurring in N.-E. Burma differs from the Khasi Hills form, *A. laodice rudra*, M., in the following respects:—

Upperside paler and spots smaller.

Underside of hindwing with subterminal pale pinkish band much broader.

Six males and one female were taken at Hthawgaw, N.E. Burma, in June, 1927.

Argynnis adippe astorica, s.sp. nov.

Male and female smaller and paler than *jainadeva*, M., above and below, but darker and larger than *pallida*, Ev. A large series was taken at Rama, Astor, in August.

Argynnis adippe gyala, s.sp. nov.

Male. *Upperside* rather similar to *jainadeva*, M. Female. Very like the male, but paler. *Underside* of hindwing with all silver spots large; in interspace 7 the third silver spot from base large and well separated from the fourth; an inner discal row of small silver spots above and close to the discal row.

Three males and a female were kindly given me by Col. Bailey, and were taken at Gyala, S.-E. Tibet, in July.

Argynnis pales hunzaica, s.sp. nov.

Male. *Upperside* with all markings on both wings much smaller and less pronounced than in *A. pales sipora*, M. *Underside* of forewing with no spots on disc of wing; a subapical brown streak pointing to the dorsum; below this there is a submarginal row of five small black spots in 6-2, the spots in 2 and 3 being more inwardly placed. Hindwing ground-colour more extensive and yellowish than in *A. pales sipora*, M.; submarginal spots blackish-red and conspicuous.

The hindwing is of a different shape to *sipora*, M., in *hunzaica* the termen is round; in *sipora*, M., it is rather straight from the apex to vein 4, and then sharply bent inwards to the tornus, giving the wing rather a square look.

Eight males and a female were taken by my native collectors at Mizgah, Hunza, in August.

ERYCINIDAE.

Dodona dipoea dipoea, Hew.

Two males were obtained at Hthawgaw, N.E. Burma. I believe this form has not previously been recorded from Burma.

Dodona dracon, de Nicév.

There are two forms of ♀ differing considerably from one another:—

1st form. A single female taken at Hthawgaw, N.-E. Burma, in September, only differs from the male from the same locality in being larger and all markings on upperside and underside being larger and paler.

2nd form. A single female taken at Bhamo, N. Shan States, in July, and a single female taken at Loimwe, in December, differ from the 1st form in being more ochreous-brown with all the pale markings being tinged with ochreous on the forewing, and very ochreous on the hindwing.

The males vary a good deal according to locality:—

Four males taken near Putao, extreme north of N.-E. Burma, are much smaller and form a separate subspecies.

Eighteen males, taken at Hthawgaw, N.-E. Burma; two males at Bhamo, N. Burma; and ten males taken at Loimwe, S. Shan States, agree with each other fairly closely; the form from Loimwe and Bhamo on the whole has the markings on the underside rather narrower than the form from Hthawgaw; the female from Hthawgaw however, as previously stated, differs from the female from Bhamo and Loimwe, and if this difference is constant the form from Hthawgaw will require a new name.

The type of *D. dracon,* de N., is stated by Fruhstorfer as coming from the Ruby Mines, N. Burma, which is a good deal south of Hthawgaw but much further north than Loimwe.

Dodona dracon putaoa, s.sp. nov.

Male. Much smaller than *D. dracon,* de N. Upperside markings very similar, except on the forewing the spots are fulvous and not white. *Underside* much warmer and darker reddish-ochraceous; markings rather broader.

As previously stated, four males were taken at Putao on the extreme north of N.-E. Burma. The female was not obtained.

Dodona adonira, Hew.

The collective species has been divided into two races, *D. adonira adonira,* Hew., from Sikkim-Bhutan, and *D. adonira argentea,* Fruh., from the Ruby Mines, N. Burma.

Fruhstorfer states that *argentea* differs from the Sikkim form in having a black base to forewing instead of a brown one, a much broader black distal border, and more extensive submarginal band. On underside, the long longitudinal bands are not black but brown; the space between the two submarginal bands and the two basal bands, as well as the subanal region, are covered with broad silvery stripes; also at the costal margin there is a square silvery spot.

I have not seen any specimens from the Ruby Mines where the type came from, and I have no forms which agree *altogether* with Fruhstorfer's description. The nearest locality to the Ruby Mines from which I have received a male is Bhamo, 120 miles away. This might be considered to be typical, except that it has not a black base to the fore and hindwings, but agrees with Sikkim specimens in this respect.

On the other hand I have before me numerous specimens from the Naga and Manipur Hills; from Hthawgaw, 150 miles North of Bhamo; and from the extreme S.-E. of the Shan States, about 300 miles S.-E. of the Ruby Mines, which vary a good deal and may form new subspecies.

Fruhstorfer considered specimens from the Naga Hills and Bernardmyo might be referable to his *argentea.* The Naga Hills are a very long distance from the Ruby Mines, whereas Bernardmyo is so close to the Ruby Mines that there can be no doubt specimens taken there by Doherty are typical; on the other hand specimens from the Naga Hills, as before stated, may form a new sub-species.

The following key will assist in separating the *adonira* from Assam, and the Burma forms of Fruh.

(*A*) *Upperside*: base of both wings brown and not as dark as the black margin of the forewing.

(*ai*) *Upperside*: very similar to *D. adonira* from Sikkim, but on the *underside* the markings are not quite so black, and the hindwing has the silvery markings of *argentea* but not quite so conspicuous.

Dodona adonira naga, s.sp. nov. Naga Hills, Manipur.

(*aii*) *Upperside*: fulvous markings broader and paler than the Sikkim form. *Underside*: all markings very narrow and fulvous.

D. adonira argentea, Fruh. Ruby Mines, Upper Burma.

(*B*) *Upperside*: base of both wings very dark, almost the same colour as the marginal border of forewing.

(*bi*) large; markings on underside narrow, and only slightly fulvous; silvery markings well developed.

D. adonira kala, s.sp. nov. Hthawgaw, N.-E. Burma.

(*bii*) smaller; markings of *upperside* similar. *Underside*: dark bands on both wings broader and markedly fulvous; silver spaces still more developed.

D. adonira learmondi, s.sp. nov. Loimwe, S. Shan States.

Abisara chela amplifascia, s.sp. nov.

The male differs from the typical form from Sikkim in having the white band on both sides of the forewing much wider.

Two males were obtained on the Irang River, Manipur, in March and April; fourteen males at Sadon, N.-E. Burma, in October—December; a male taken in the Abor Hills in July belongs to this form; it is a wet season form and the white band is slightly narrower but still very much broader than the Sikkim form.

LYCAENIDAE.

Allotinus drumila grisea, Riley and Godfrey.

The type was described from a single extreme dry season female from Siam, taken in April. A large series was obtained at Kalaw, S. Shan States, and at Loimwe on the extreme east of the S. Shan States, close to the Siam border.

The male is very close to the typical form, and only differs in the apical pale band not being so pure white. The females, taken at Kalaw in October, belong to the wet season, the ground-colour is brown and not whitish; those caught in November are transitional forms to the dry season form, and one specimen agrees entirely with the type.

Lycaena tseng mandersi, Elwes.

This form only differs from the typical form from China in the colour of the upperside which is much brighter.

Six males were obtained at Hthawgaw, N.-E. Burma, and a female in the Bhamo Hills. A male was also obtained in Kalaw, S. Shan States.

The type, a male, was taken at Bansan, Shan States.

Surendra learmondi, sp. nov.

Female. *Upperside* dark blackish-brown, with a large bright purple patch filling the cell and inner half of forewing and cell of hindwing; in one specimen the cell of hindwing has only a little blue towards its apex. *Underside* vinous-brown with purplish-black spots, mostly rectangular. Forewing with two spots in cell, with a costal spot over the outer one; a large spot closing the cell, with a spot above and below it; a post-discal row of six spots in echelon, those in 2, 4 and 6 being placed more outwardly than those in 3, 5 and 7. Hindwing with four basal round spots, followed by a discal and post-discal band composed of peculiarly shaped markings, hard to describe; a well defined lobe at tornus, and a fairly long and stout tail.

Expanse: ♀, 42 m.m.

Two females were obtained at Loimwe, S. Shan States, in June. It is a very distinct species and unlike anything I know.

Spindasis learmondi, sp. nov.

Male. *Upperside* very like *S. nipalicus evansi*, Tytl., but smaller tornal area of hindwing in two specimens, not marked with black spots, one specimen with a maroon spot; inner tail rudimentary, outer tail thicker and mostly maroon with a white tip. *Underside* plumbeous wine-colour; markings on outer margin inclined to be obsolescent, a maroon spot at tornus. This is a very distinct species and unlike anything I know; the underside is very distinctive. It agrees with *S. mascinus*, Elw. in having only the outer tail fully developed, the inner one being rudimentary.

Pratapa vidura vidura, Horsfield.

Mr. G. Cooper has taken in Mergui several specimens of a form which agrees with the type from Java. There is a specimen from Lower Burma in the B. M. over the label *P. burmana*, M., and there is also a specimen from Perak over the label *D. v. vidura*, Horsf.

It can easily be distinguished from *D. v. burmana* by the greater development of the orange spot above the inner tail of the hindwing.

It would appear that typical *vidura* extends to the extreme end of S. Burma, and *burmana* is from further north. The type of *burmana* was taken at Moulmein.

Tajuria luculentus luculentus, Leech.

Two males, which appear to be nearer the typical form than to *T. l. nela*, Swinh., were taken at Loimwe.

Tujuria mantra, Feld.

Two females of this rare form were taken at Maymyo in July.

Tujuria yajna ellisi, Evans, ♀.

The female, which I believe is undescribed, is very similar to the ♂, but on the upperside the blue is rather duller, and on the forewing is more extended; underside ground colour much paler.

Biduanda melisa cooperi, s.sp. nov.

Mr. G. Cooper took several specimens of a *melisa* which differ from typical specimens from further south in having the blue area on the hindwing dark purplish-blue as in *B. m. cyara*, Hew., and not bright shining blue. It appears to be a good race. Type ♂ from Maymyo, Anisakan.

There is a specimen in the B.M. taken by Mr. Godfrey in S.-E. Siam, in April, 1914.

N.B.—The location of the types of *Spindasis learmondi* and *Tajuria yajna ellisi* ♀, omitted by the author, cannot be given as the specimens are not available. The former probably came from Loimwe (G. T.).

A CONTRIBUTION TO THE FLORA OF THE PUNJAB PLAINS AND THE ASSOCIATED HILL REGIONS

BY

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The flora of the Punjab plains is closely related to the floras of the Indian desert and Sind and shows considerable similarity to the plant population of the latter.

The area dealt with is approximately enclosed by the lines joining the South-West end of the Punjab to Mianwali, from Mianwali to Gujrat, south of the Salt Range, and from Gujrat through Amritsar, Ludhiana and Saharanpur to the South end of the Punjab. It includes the following districts:—

Bahawalpur, Muzaffargarh, Multan, Mianwali up to Salt Range, Montgomery, Lyallpur, Jhang, Shahpur, Gujrat south of Salt Range, Gujranwala, Lahore, Amritsar, Ferozepore, Ludhiana, Patiala, Hissar, Jind, Nabha, Karnal up to railway-line, Ambala, Saharanpur, Rohtak, Gurgaon, (the Jumna to form the E. boundary of the regions).

The plants from the associated hill regions are also included to determine to what altitude the same species can grow.

The present contribution is compiled from the data obtained from the plant collections in the Herbarium of the Forest Research Institute, Dehra Dun. Original notes made by the several plant collectors are also incorporated. Localities mentioned under distribution are largely drawn from the Flora of the British India by Hooker. The Flora represents 118 families which include 530 genera and 949 species.

I wish to take this opportunity to thank Mr. C. E. Parkinson for facilities for studying the collections in the Herbarium of the Forest Research Institute, Dehra Dun.

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I. RANUNCULACEAE.

1. Clematis *L.*

1. **Clematis Gouriana** Roxb. Hort. Beng. (1814), 43.

Locality.—Dalhousie (Drum. 66a !); Sindhiara in Chamba (66a !); Jhelum and Hoshiarpur (Ait. 436 !).
Flowers.—August-September.
Distribution.—Java, Philippines. India—hilly districts from the Western Himalaya, alt. 1-3,000 ft., to Ceylon and the Eastern Peninsula.

2. **Clematis grata** Wall. Cat. (1828), 4,668.

Locality.—Dalhousie (Drum. 4,586 !, 68 !, 67 !, 70 !).
Flowers.—May-September.
Distribution.—Afghanistan, China, Tropical Africa. India—subtropical and temperate Himalaya, from Kumaon westwards, alt. 2-8,000 ft.

3. **Clematis graveolens** Lindl. in Journ. Hort. Soc. I (1846) 307.

Locality.—Kunawar (Nanak 1138 !).
Flowers.—July-September.
Distribution.—India—W. temperate Himalaya, from Murree to Kulu and Kumaon, alt. 6-11,000 ft.

4. **Clematis Buchananiana** DC. Syst I (1818), 140.

Locality.—Dalhousie (Drum. 71 !).
Flowers.—August-November.
Distribution.—India—throughout temperate Himalaya, alt. 5-10,000 ft.

5. **Clematis flammula** L. Sp. Pl. 544.

Locality.—Lahore, gardens (Parker 13622 !, 13769 !).
Flowers.—June-September.
Distribution.—Mediterranean region,

2. Thalictrum *L.*

6. **Thalictrum foliolosum** DC. Syst. I, 175.

Locality.—Dalhousie (Drum. 79).
Flowers.—August.
Distribution.—India—temperate Himalaya, alt. 5-8,000 ft.; Khasia Hills, alt. 4-6,000 ft.

3. Ranunculus *L.*

7. **Ranunculus aquatilis** L. Sp. Pl. 556.

Locality.—Rawalpindi (Ait. 333 !).
Flowers.—March.
Distribution.—Temperate N. and S. hemispheres. India—W. Himalaya, from Kumaon to Indus; plains of the Punjab, as far south as Delhi and Saharanpur. East and West Tibet.

8. **Ranunculus sceleratus** L. Sp. Pl. (1753) 551.

Locality.—Ludhiana (Drum. 1172 !); Karnal (Drum. 3020 !); Lahore (Stewart 2821 !); Rawalpindi.
Flowers.—January-April.
Distribution. Throughout the N. Temperate Zone. India—river banks in Bengal and Northern India; marshes of Peshawar, warm valleys of the Himalaya; (unknown south of the Nerbudda).

9. **Ranunculus pensylvanicus** Linn.

Locality.—Karnal (Drum. 4336 !, 6278 !).
Flowers.—August.
Distribution.—North China; Amurland; N. America. India.

10 **Ranunculus muricatus** L.

Locality.—Gurdaspur (Drum. 81 !); Lahore (Parker !); Rawalpindi (Ait. 306 !); Near Peshawar (Collett !).
Flowers.—February-April.
Weed in wet places.
Distribution.—Europe, W. Asia, temp. N. America.
India—swampy places, at low elevations, in the Punjab-Himalaya, and in the plains at Peshawar and Ambala.

11. **Ranunculus arvensis** L.

Locality.—Rawalpindi (Ait. 305 !); near Peshawar (Collett !).
Flowers.—February-April.
In wet places.
Distribution.—Europe, Asia Minor, Afghanistan, Western Siberia. India—Western Himalaya, from Kashmir to Kumaon.

4. Delphinium *L.*

12. **Delphinium saniculaefolium.** Boiss. Fl. Orient I, 91.

Locality.—Rawalpindi (Ait. 307 !).
Flowers.—March.
Distribution.—Afghanistan. India—W. Punjab, on the dry hills from the Indus to the **Jhelum.**

13. **Delphinium denudatum** Wall. Cat. No. 4719.

Locality.—Dalhousie (Drum. 87 !).
Flowers.—July.
Distribution.—India—W. temperate Himalaya, from Kashmir to Kumaon in grassy places.

II. MAGNOLIACEAE.

5. Michelia *L.*

14. **Michelia Champaca** *L.*

Locality.—Hoshiarpur (Ait. 555 !).
Distribution.—Java. India—commonly cultivated; but wild in the forests of the temperate Himalaya, from Nepal eastwards, and in Pegu, Tenasserim and Travancore.

III. ANONACEAE.

6. Unona *L.*

15. **Unona discolor** Vahl. Symb. II 63, t. 36.

Locality.—Lahore-Govt. Gdns. (Parker 13621 !).
Flowers.—June.
Distribution.—Malayan Archipelago (all the forms). India-Tropical forests from Sikkim, Assam and Silhet, to Arakan and Malacca, Orissa and Konkan.

7. Polyalthea *Bl.*

16. **Polyalthea longifolia** Benth & H. f. Gen. Pl. I, 25.

Locality.—Hoshiarpur (Ait. 552 !); Parker 14383.
Flowers.—May.
Distribution.—Drier parts of Ceylon. Cultivated throughout the hotter parts of India.

IV. MENISPERMACEAE.

8. Tinospora *MIERS.*

17. **Tinospora cordifolia** Miers. Contrib. iii, 31.

Locality.—Karnal (Drum. Herb. 6291 !).
Flowers.—April.
Distribution.—Throughout India from Kumaon to Assam and Burma, and from Bihar and Konkan to Ceylon and the Carnatic.

9. Cocculus *DC.*

18. **Cocculus Leaeba** DC. Prodr. I, 99.

Locality.—Rawalpindi (Ait. 175 !); Montgomery (Parker 6263 !); Changa Manga (Kanjilal !).
Flowers.—September; *Fr.*—November.
Distribution.—Afghanistan, Arabia, tropical and subtropical Africa. India—drier parts of Western India, the Punjab, Sind and the Carnatic.

19. **Cocculus villosus** DC. Prodr. I, 98.

Locality.—Karnal (Drum. 1647 !).
***Flowers.*—May.**
Distribution.—Tropical Africa. Throughout tropical and subtropical India—from the base of the Himalaya to Malabar and Pegu (absent in the Eastern Peninsula and Ceylon).

10. Cissampelos *L.*

20. **Cissampelos Pareira** *L.*

Locality.—Karnal (Parker 1220 !, 1221 !); Rawalpindi (Ait. 717 !); Alt. 4,000-5,000 (Jerram !); Dalhousie (Drum. 90 !, 91 !).
Flowers.—August.
Distribution.—Cosmopolitan in warm regions. India—tropical and subtropical, from Sind and the Punjab to Ceylon and Singapore.

V. BERBERIDACEAE.

11. Berberis *L.*

21. **Berberis Lycium** Royle Ill. 64.

Locality.—Rawalpindi (Jerram !).
Flowers.—April.
Distribution.—India—Western Himalaya, in dry places, alt. 3-9,000 ft. from Gharwal to Hazara.

VI. NYMPHAEACEAE.

12. Nymphaea *L.*

22. **Nymphaea Lotus** L.

var. *pubescens* H. f. & T. Fl. Ind. 241.
Locality.—Rawalpindi (308 !).
Flowers.—August.

Distribution.—Africa, Hungary, Java, Philippine Islands. India—common throughout the warmer parts.

23. **Nymphaea stellata** Willd.

Locality.—Hoshiarpur (Ait. 289 !).
Distribution.—Africa. India—common throughout the warmer parts.

13. NELUMBIUM *Juss.*

24. **Nelumbium speciosum** Willd.

Locality.—Rawalpindi (Ait. 421 !).
Distribution.—Persia, Malay Islands, China, Japan, tropical Australia, India—throughout, extending as far to the N.-W. as Kashmir.

VII. PAPAVERACEAE.

14. PAPAVER *L.*

25 **Papaver Hookeri** Baker ex. Hook. f. Bot. Mag. t. 6729.

Locality.—Lahore (Stewart 2580 !); Karnal (Drum. 6293 !).
Flowers.—March.
Distribution.—India—Punjab.

15. ESCHSCHOLTZIA *CHAM.*

26. **Eschscholtzia californica** Cham. in Nees. Hor. Phys. Berol. 74.

Locality.—Islamia College Peshawar (Quizilbush 56 !).
Distribution.—California.

VIII. FUMARIACEAE.

16. CORYDALIS *DC.*

27. **Corydalis cornuta** Royle Ill. 69.

Locality.—Dalhousie (Drum. 97, 99).
Distribution.—India—temperate Himalaya, alt. 8-10,000 ft.

17. FUMARIA *LAMK.*

28. **Fumaria parviflora** Lamk.

Locality.—Islamia College, Peshawar (Quizilbush 8 !); Lahore (Parker 10 !; Brandis 2954; Stewart 2832 !).
Distribution.—India—Indo-Gangetic plain, lower Himalaya and Nilgiri Hills; a weed of cultivation.

IX. CRUCIFERAE.

18. NASTURTIUM *Br.*

29. **Nasturtium officinale** Br. in Hort. Kew. ed. 2 IV, 110.

Locality.—Rawalpindi (Ait. 176 !, 312 !).
Flowers.—September.
Has been introduced in Salt Range.
Distribution.—Afghanistan, temperate Europe and Asia. India—Rohilkhand, Punjab, also found near all the hill stations, but probably introduced.

30. **Nasturtium palustre** DC. Syst. Veg. II, 191.

Locality.—Rawalpindi (Ait. 1007 !).
Flowers.—March. The fruit peculiarly large and bloated.

Distribution.—Many temperate regions. India—abundant in temperate Himalaya, ascending to 10,000 ft., and in N.-W. India, rare in Assam and Bengal.

19. ARABIS *L.*

31. **Arabis taraxacifolia** Anders.

Locality.—Rawalpindi (Ait. 319 !).
Flowers.—March.
Distribution.—India—Punjab.

20. FARSETIA *DESV.*

32. **Farsetia Jacquemontii** H. f. & T. Journ. Linn. Soc. V, 148.

Locality.—Hissar (Duthie 38331); Multan (1886, Munro 29 !, 61 !, 185 ! 348 !, Duthie 10784 !), Punjab (Ait. 424 !), Lahore (Stewart 2834 !, 2610 !. 2574 !).
Flowers.—April-December.
Eaten as a tonic, small branches eaten raw. Chutney prepared from it.
Distribution.—Afghanistan, Baluchistan. India—sandy places in the Punjab and Sind.

21. MALCOMIA *Br.*

33. **Malcomia africana** Br. Hort. Kew. ed. 2 IV, 121.

Locality.—Rawalpindi (Ait. 315 !); Lahore (Parker !; Stewart 2514 !).
Weed in wheat crop.
Distribution.—W. Asia; Mediterranean region. India—fields and waste places in the Punjab, Kashmir and Western Tibet, ascending to 13,000 ft.

34. **Malcomia africana** Br.

var. *gracilis* O. E. Schulz.
Locality.—Muzaffargarh (Monro 161 !).
Flowers.—March.
Eaten by cattle.
Distribution.—S. Europe; Orient.

35. **Malcomia strigosa** Boiss. Fl. Orient. I, 224.

Locality.—Rawalpindi (Ait. 316 !, 160 !).
Flowers.—Mach-July.
Distribution.—Afghanistan, Baluchistan, Persia. India—in the Salt Range, Punjab.

22. SISYMBRIUM *L.*

36. **Sisymbrium Thalianum** Gay & Monn. in Gaud. Fl. Helv. IV, 348.

Locality.—Dalhousie (Drum. 105 !); Barrakow near Rawalpindi (Ait. 1142 !).
Flowers.—March.
Distribution.—Temperate Europe, Asia, Abyssinia. India—temperate Himalaya from Bhotan to Kashmir, and in Western Tibet, alt. 5-10,000 ft.

37. **Sisymbrium rupestre** Edgew. in Trans. Linn. Soc. XX, 33.

Locality.—Peshawar (Quizilbush 391 !).
Distribution.—India—in the dry regions of the Western Himalaya, from Kumaon to Kashmir, alt. 8-14,000 ft.

38. **Sisymbrium strictum** H. f. & T. Jour. Linn. Soc. V, 161.

Locality.—Dalhousie (Drum. 107 !, 111 !, 112 !).
Distribution.—India—Western Himalaya from Kumaon to Kashmir, alt. 5-10,000 ft.

39. **Sisymbrium Columne** Jacq. Fl. Austr. t. 323.

Locality.—Rawalpindi (Ait. 318 !).
Flowers.—March.
Distribution.—Westwards to Central Europe. India—Western Himalaya from Kumaon to Kashmir, ascending to 10,000 ft.

40. **Sisymbrium Irio** L.

Locality.—Rawalpindi (Ait. 313 !, 317 !).
Flowers.—April.
Distribution.—Afghanistan and westwards to the Canary Islands. India—Northern India from Rajputana to the Punjab.

41. **Sisymbrium Irio** L.

var. *dissectum* O. E. Schulz.
Locality.—Lahore (Stewart 2575 !, 2576 !).

23. BRASSICA *L.*

42. **Brassica campestris** L.

Locality.—Rawalpindi (Ait. 320 !).
Flowers.—February.
Distribution.—Cultivated for its seed for oil throughout India.

43. **Brassica alba** H. f. & T.

Locality.—Rawalpindi (Ait. 321 !).
Flowers.—April.
Distribution.—From Syria eastwards throughout S. Europe. India—cultivated fields at Ferozepore in the Punjab.

24. CAPSELLA *MOENCH.*

41. **Capsella Bursa-pastoris** Moench.

Locality.—Peshawar (Quizilbush 26 !).
A weed of cultivation.
Distribution.—Cultivated places throughout temperate India.

25. LEPIDIUM *L.*

45. **Lepidium sativum** L.

Locality.—Lahore (Parker 21038 ! ; Stewart 2515 !) ; Rawalpindi (Ait. 324 !).
Flowers.—March.
Weed in wheat crop (Aitchison) ; but cultivated and spread, not indigenous.
Distribution.—Cultivated throughout India and Western Tibet.

46. **Lepidium Draba** L.

Locality.—Rawalpindi (Ait. 1012).
Distribution.—Westwards to Europe. India—a weed of cultivation in the Punjab.

26. THLASPI *L.*

47. **Thlaspi arvense** L.

Locality.—Rawalpindi (Ait. 1015 !).
Flowers.—March.
Distribution.—Europe, Asia, always in cultivated places. India—a weed of cultivation throughout the temperate and subalpine Himalaya, ascending to 14,000 ft.

27. NESLIA *DESV.*

48. **Neslia paniculata** Desv. Jour. III, 162.

Locality.—Rawalpindi (Ait. 323 !).
Flowers.—March.
Distribution.—Persia, Western Asia, temperate Europe. India—in the Punjab-Himalaya, from Hazara to the Beas; Kashmir, alt. 5-6,000 ft.

28. EUCLIDIUM *Br.*

49. **Euclidium syriacum** R. Br. in Hort. Kew. ed. 2, IV, 74.

Locality.—Rawalpindi (Ait. 1015 !).
Flowers.—March.
Distribution.—Westwards to Central Europe. India—Kashmir, alt. 5-6,000 ft., Punjab at Peshawar.

29. GOLDBACHIA *DC.*

50. **Goldbachia laevigata** DC. Syst. II 577.

Locality.—Rawalpindi (Ait. 325 !).
Flowers.—March.
Distribution.—Westwards to S. Russia. India—Kashmir, alt. 5,000 ft., common in the Punjab.

X. CAPPARIDACEAE.

30. CLEOME *L.*

51. **Cleome papillosa** Steud. Nomencl. ed. 2., I. 382.

Locality.—Rawalpindi (Ait. 573 !, 139 !).
Flowers.—August-October.
Distribution.—Abyssinia; Kordofan; Arabia. India—Rajputana and arid districts of Sind and Western Punjab.

52. **Cleome brachycarpa** Varl ex DC. Prodr. I, 240.

Locality.—Lahore (Stewart 2508 !); Hissar (Duthie 3837 !); Punjab (Ait. 196 !).
Flowers.—August.
Distribution.—Arabia, Abyssinia. India—N.-W. India from Agra to Peshawar.

53. **Cleome viscosa** L.

Locality.—Rawalpindi (Ait. 326 !); Lahore (Stewart 2507 !).
Flowers.—August.
Distribution.—Abundant throughout tropical and warm India and the rest of the world.

31. GYNANDROPSIS *DC.*

54. **Gynandropsis pentaphylla** DC. Prodr. I, 238.

Locality.—Rawalpindi (327); Multan (* Monro 65 !); Hissar (Duthie 3839 !).
Flowers.—June-August.
* Leaves collected and made into plaster for sores. Leaves and flowers eaten cooked.
Distribution.—Abundant throughout the warm parts of India and all tropical countries.

32. Maerua *FORSK.*

55. **Maerua arenaria** H. f. & T.

Locality.—Hissar (Duthie 3840 !).
Flowers.—August.
Distribution.—India—Western Himalaya and Central India abundant.

33. Cadaba *FORSK.*

56. **Cadaba indica** Lamk.

Locality.—Lahore—Changa Manga. (* Parker 14877); Kanjilal ! ; Chatterji 129 ! ; Montgomery, Okara (Parker 4563 !).
Flowers.—November-January ; Fr. January.
Distribution.—India—Western Peninsula, from Gujrat and the Konkan southwards, on old walls and in waste dry plains. * On unirrigated canal belt.

34. Capparis *L.*

57. **Capparis spinosa** L.

Locality.—Bashahr (18256 !, 18128 !, 17131 !, 18125 !) ; Jhelum (J. Prasad 32 ! alt. 2000) ; Rawalpindi (Ait. 177 !).
Flowers.—August-November.
Distribution.—Afghanistan, West Asia, Europe, N. Africa, Australia, Sandwich Islands. India—hot western Himalayan valleys eastwards to Nepal ; West Tibet, ascending to 13,000 ft.

58. **Capparis aphylla** Roth.

Locality.—Multan (Ram Nath 47327 !) ; Fatehganj in Rawalpindi (Ait 328 !) ; Hissar (Duthie 3842 ! 4512 !) ; Lahore (Ram Nath 17952 !).
Flowers.—April-August ; Fr. October to December.
Distribution.—Arabia, Egypt, N. tropical Africa. India—driest places in the Punjab, Sind, Gujrat, Rajputana, the Deccan and South Carnatic.

59. **Capparis sepiaria** L.

Locality.—Hissar (Duthie 3841 !, 3843 !) ; Karnal (Parker 1254 !).
Flowers.—August.
Distribution.—Philippines, Ceylon. Dry places throughout India, from the Punjab and Sind to Burma, the Carnatic and Pegu.

60. **Capparis horrida** L.

Locality.—Hoshiarpur (Ait. 565 !).
Distribution.—Java, Philippines, Ceylon. India—Gangetic plain, Western Peninsula, Chittagong to Pegu.

35. Crataeva *L.*

61. **Crataeva religiosa** Forst.

Locality.—Jhelum (Ait.).
Distribution.—Tropical Africa. India—near streams in Malabar and Canara ; cultivated elsewhere in India.

XI. RESEDACEAE.

36. Oligomeris *CAMB.*

62. **Oligomeris glaucescens** Cambess.—in Jacq. Voy. Bot. 23, t. 25.

Locality.—Multan (Monro 247 !) ; Lahore (Stewart 2519 !) ; Hoshiarpur (Ait. 70 !) ; Rawalpindi (Ait. 697 !).

Flowers.—March-April.

Distribution.—Westwards to Spain and the Canaries. India—Sind, and the Punjab, from the Jumna eastwards, common; rare in the Konkan hills.

XII. VIOLACEAE.

37. VIOLA *L.*

63. **Viola Patrinii** DC. Prodr. I, 293.

Locality.—Peshawar, College (Quizilbash 34 !).

Distribution.—Afghanistan, N. Asia, Japan, Middle Russia. India—temperate Himalaya, alt. 4-8,000 ft. from Kashmir to Bhotan, Western Tibet, Khasia Hills, hills of the Western Peninsular, Ceylon.

64. **Viola serpens** Wall. in Roxb. Fl. Ind. ed. Wall. II 449 (not of Cat.) and in DC. Prodr. I, 296

Locality.—Hoshiarpur (Ait. 541 !).

Distribution.—Java, China. India—moist woods, etc., throughout temperate Himalaya, Khasia Hills, Pulney and Nilgiri Hills and Ceylon, alt. 5-7,000 ft.

65. **Viola cinerea** Boiss, Fl. Orient I, 454.

Locality.—Rawalpindi (Ait. 30 !).

Distribution.—Afghanistan, Persia, Arabia. India—dry hilly regions of the Punjab and Sind, common.

66. **Viola tricolor** L.

Locality.—Rawalpindi (Ait. 331 !); Lahore (Stewart 2822 !).

Flowers.—April. Cultivated. A garden escape.

Distribution.—Europe, Asia and N. America.

XIV. BIXACEAE.

38. FLACOURTIA *Comm.*

67. **Flacourtia Ramontchi** L' Hérit Stirp. 59, t. 30, 31.

Locality.—Kalesar, alt. 1,200 ft. (Lace 11 !).

Flowers.—March.

Distribution.—Madagascar, the Eastern Archipelago. India—Common throughout, wild or cultivated.

68. **Flacourtia Ramontchi** L' Hérit Stirp. 59, t. 30, 31.

var. *sapinda* H. f. & T.

Locality.—Hoshiarpur (Ait. 504 !); Gurdaspur (Bisram 850 !).

Flowers.—May.

Distribution.—India—common in the western Ghats and elsewhere in the Peninsula.

69. **Flacourtia sepiaria** Roxb. Cor. Pl. I, 48, t. 68.

Locality.—Lahore—Gardens (Parker 6252 !).

Flowers.—April.

Distribution.—Java. India—dry jungles throughout Bengal, the Western Peninsula; Ceylon.

39. XYLOSMA *FORST.*

70. **Xylosma longifolium** Clos. in Ann. Sc. Nat. Ser. 4, VIII, 231.

Locality.—Hoshiarpur (Ait. 597 !).

Distribution.—India—Western Himalaya on the outer ranges, ascending to 5,000 ft., from Kumaon to Murree; Assam: at Nowgang and Gowhatty.

40. ABERIA *HOCHST.*

71. **Aberia caffra** Harv & Sond. Fl. Cat. II, 584.

Locality.—Madhopur in Gurdaspur district (* Parker 14862 !, 14863 !).
Flowers.—March.
* A shrub 12 ft. high; dioecious.
Distribution.—South Africa.

XV. PITTOSPORACEAE.

41. PITTOSPORUM *BANKS.*

72. **Pittosporum floribundum** W. & A. Prodr. 154.

Locality.—Rawalpindi (6256 !, 6258 !); Bindaraban, Nurpur, Kangra District (6257 !); Kangra (21 !).
Flowers.—June-December.
Distribution.—Tolerably common along the range of the ghats in the Bombay Presidency; subtropical Himalayas.

73. **Pittosporum phillyraeoides** DC. Prodr. I, 347.

Locality.—Lahore—Gardens (Parker 11415 !).
Flowers.—February.
Distribution.—Australia.

74. **Pittosporum Tobira** Ait. Hort. Kew. ed. II, ii, 27.

Locality.—Lahore—Gardens (Parker 12966 !).
Flowers.—April.
Distribution.—Japan; China.

42. CITRIOBATUS *A. CUNN.*

75. **Citriobatus pauciflora** A. Cunn. in Lond. Hort. Brit. Suppl. I, 585.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38695 !).
Flowers.—April.
Distribution.—Australia.

XVI. POLYGALACEAE.

43. POLYGALA *L.*

76. **Polygala abyssinica** Fresen. in Mus. Senk. II 273.

Locality.—Rawalpindi, Barrakow to Tiete (Ait. 334 !).
Flowers.—September
Distribution.—Afghanistan; Abyssinia to Natal. India—subtropical and temperate Himalayas, alt. 3-8,000 ft., from Murree to Kumaon, Punjab at Multan.

77. **Polygala Hohenackeriana** Fisch. & Mey. Ind. Sem. Hort. Petrop. IV 42.

Locality.—Rawalpindi (Ait. 991 !).
Flowers.—July.
Distribution.—Afghanistan; Baluchistan; Persia; Caucasus. India—Western Punjab; Attock; Waziristan, ascending to 3,500 ft.

78. **Polygala erioptera** DC. Prodr. I 326.

Locality.—Maniniajra (Nanak 1275 !); Hissar (1288 !, 1287 !); Ludhiana (1276 !); Lahore (Stewart 2619 !).
Flowers.—March-April.
Distribution.—Kordofan; Baluchistan; Arabia; Tropical Asia and Africa. India—the Punjab; Sind; Rajputana; Bihar; the Western Peninsula; Ava; Burma.

79. **Polygala chinensis** L.

Locality.—Rawalpindi—Barrakow to Tiete (Ait. 333 !).
Flowers.—September.
Distribution.—Tropical Asia, Australia and Ceylon. India—throughout, from the Punjab to Pegu, and in the Western Peninsula.

XVII. CARYOPHYLLACEAE.

44. Gypsophila *L.*

80. **Gypsophila cerastioides** Don Prodr. 213.

Locality.—Dalhousie (Drum. 138 !); Lahore (Stewart 2907 !).
Flowers.—April.
Distribution.—India—temperate Himalaya from Kashmir and Kunwar to Sikkim, Alt. 6-12,000 ft.

45. Saponaria *L.*

81. **Saponaria Vaccaria** L.

Locality.—Lahore—Gardens (Parker 21032 ! ; Stewart 2542 !); Rawalpindi (Ait. 335 !).
Flowers.—March.
A weed of cultivation.
Distribution.—In wheat fields throughout India.

46. Silene *L.*

82. **Silene conoidea** L.

Locality.—Peshawar—Gardens (* Quizilbash 53 !); Lahore—(Stewart, 2918 ! ; Gdns-Parker 21029 !, 21030 !); Hoshiarpur (* Ait. 57 !); Rawalpindi (Ait. 336 a !); Barrakow in Rawalpindi (336 b !); Peshawar (22 !).
Flowers.—March-April.
* On this specimen may be seen both forms *conica* L. & *conoidea* L.
Distribution.—Westwards to the Atlantic Ocean. India—Western Himalaya; from Kumaon to the Indus, alt. 1-8,000 ft., and from Oudh to the Punjab in the Plains.

83. **Silene arenosa** C. Koch in Linnaea XV, 711.

Locality.—Peshawar—(Quizilbash 30 !); Rawalpindi—Hurror (Ait. 1021 !).
Flowers.—March.
Distribution.—Afghanistan; Persia; Armenia. India—Western Punjab, common at Peshawar, Attock.

84. **Silene Falconeriana** Benth. in Royle Ill. 79, t. 20.

Locality.—Dalhousie (Duthie 136 !).
Distribution.—India—Western Himalaya, from Kumaon to Kunwar, alt. 3-9,000 ft.

47. Stellaria *L.*

85. **Stellaria media** L.

Locality.—Lahore (Stewart 2544 !); Changa Manga (* Parker 21714); Lahore-Nowoagarh (Stewart 2993 !); Cachrah (Stewart 2914 !); Rawalpindi (Ait. 337).
* In most shady places. Completely covers the ground after good winter rain or cold weather irrigation.
Distribution.—Throughout the Punjab and temperate regions of India, ascending in the Himalaya to 12,000 ft. Ceylon, all Arctic and N. temperate regions; a doubtful native elsewhere.

48. *Arenaria* *L.*

86. **Arenaria serpyllifolia** L.

Locality.—Hoshiarpur (Ait. 334 !).

49. *Spergula* *L.*

87. **Spergula arvensis** L.

Locality.—Lahore—Gardens (Parker 21704 !); Rawalpindi—Futtehganj (Ait. 1022 !).
Flowers.—March-April.
Distribution.—Cultivated fields in various cool parts of India; and throughout the Northern hemisphere.

88. **Spergula pentandra** L.

Locality.—Lahore (Stewart 2586 ! 2587 !); Lyallpur (Inayat 27 !); Hoshiarpur (Ait. 577 !).
Flowers.—March.
Distribution.—Cultivated fields in various cool parts of India; and throughout the Northern hemisphere.

89. **Spergula rubra** L.

Locality.—Lahore (* Stewart 2911 !, 2588).
Flowers.—March.
* Named *S. pentandra* L. in the Brandis collection.
Distribution.—Europe.

XVIII. PORTULACACEAE.

50. *Portulaca* *L.*

90. **Portulaca oleracea**

Locality.—Rawalpindi (Ait. 339 !).
Flowers.—July.
Distribution.—Throughout India ascending to 5,000 ft. in the Himalayas; all warm climates.

XIX. TAMARICACEAE.

51. *Tamarix* *L.*

91. **Tamarix Troupii** Hole in Indian Forester, 1919 XIV 248.

Locality.—Montgomery—Chichwatni (Parker 20781 !, 20778 !, 20782 !, 20783 !, 20779 !, 20787 !); Hoshiarpur (Ait. 625 !); Ludhiana (Duthie 10791 !).
Flowers.—September-December.
Distribution.—Orient. India.

92. **Tamarix dioica** Roxb. Hort. Beng. 22.

Locality.—Montgomery—Chichwatni (Parker 20513 !, 20515 !, 20518 !, 20517 !); Multan (Monro 36 !; Duthie 10792 !); Rawalpindi (Ait. 346 !).
Flowers.—September-December.
Distribution.—India—from Rajputana, Sind and the Punjab to Assam, the W. Peninsula and Burma, near rivers and on the Sea Coast.

93. **Tamarix articulata** Vahl, Symb. II 48, t 32.

Locality.—Changa Manga (* Parker 21223 !); Lahore (Parker 6048 !; 38776 !); Rawalpindi (Ait. 341 !); Montgomery—Chichwatni (Parker 20522 !; 20521 !).
Flowers.—August-October.
* Small tree with nearly smooth bark.

Distribution.—Baluchistan; Algeria; S. Africa; Egypt; Arabia. India—very common, especially on Kalar soil throughout Sind, abundant in the Punjab.

94. **Tamarix Parkeriana** Hole. Vern. N. *Phitlai.*

Locality.—Montgomery—Chichwatni (Parker 20734!, 20777!, 20733!, 20774!, 20731!, 20735!, 20736!, 20737!, 20776!, 20739!, 20740!).
Flowers.—September.

XX. ELATINACEAE.

52. Bergia *L.*

95. **Bergia aestivosa** W. & A. Prodr. 41.

Locality.—Lahore (* Parker 12971!); Multan (Monro 225!).
Flowers.—April; pink.
* Branches lying flat on the ground.
Distribution.—India—Punjab.

XXI. HYPERICACEAE.

53. Hypericum *L.*

96. **Hypericum cernuum** Roxb. Hort. Beng. 59.

Locality.—Dalhousie (Drum. 4827!).
Distribution.—India—W. temperate Himalaya.

97. **Hypericum patulum** Thunb. Fl. Jap. 295.

Locality.—Dalhousie (Drum. 4834!).
Distribution.—Japan; Formosa. India—throughout temperate Himalaya; Khasia Hills.

XXII. DIPTEROCARPACEAE.

54. Shorea *ROXB.*

98. **Shorea robusta** Gaertn. f. Fruct. III, 48, t. 186.

Locality.—Hoshiarpur (* Ait. 539!).
* Quite wild.
Distribution.—Tropical Himalaya, and along its base from Assam to the Sutlej; Eastern districts of Central India, W. Bengal hills.

XXIII. MALVACEAE.

55. Althaea *L.*

99. **Althaea rosea** L. Cav. Diss. II, 91, t. 29. f. 3.

Locality.—Lahore (Stewart 2573!).
Distribution.—Orient.

56. Sida *L.*

100. **Sida humilis** Willd.

Locality.—Jullandur (9727!); Gurdaspur (Drum. 4633!).
Flowers.—December.
Distribution.—Tropical Africa and America. Generally distributed throughout the hotter parts of India.

101. **Sida spinosa** L.

Locality.—Changa Manga (* Parker 15042 !).
Flowers.—October.
* Common; 2-3 occasionally 5 ft. high.
Distribution.—Tropical and subtropical regions of both hemispheres. Hotter parts of India, from the N.-W. Provinces to Ceylon, Rajputana, Sind.

102. **Sida grewioides** Guill. & Perr. Fl. Seneg. I, 71.

Locality.—Hoshiarpur (20698 !); (Duthie 3876 !); Pabbi Hills (Parker 24328 !).
Flowers.—October-December.
Distribution.—Baluchistan; Arabia; Tropical Africa. India—N.-W. Provinces, Rajputana, Sind.

103. **Sida rhombifolia** L.

Locality.—Rawalpindi (Ait. 344 !).
Flowers.—September.
Distribution.—Tropics of both hemispheres. Widely distributed throughout India.

104. **Sida cordifolia** L.

Locality.—Gurdaspur-Madhopur (Parker 14350 !, 14351 !, 1,000 ft.); Jullandur (Parker 9726 !).
Flowers.—November-February.
Distribution.—Generally distributed throughout tropical and subtropical India and both hemispheres. A tropical weed.

57. Abutilon *GAERTN.*

105. **Abutilon indicum** G. Don. Gen. Syst. I 504.

Locality.—Gurdaspur (Drum. 152 !); Lahore (Parker 7876 !; Stewart 2956 !, 2828 !).
Flowers.—December-March.
Distribution.—Baluchistan and Tropics. India—Rajputana, Sind; Ceylon.

106. **Abutilon bidentatum** Hochst. in A. Rich. Fl. Abyss. I, 68.

Locality.—Hissar (Duthie 3875 !); Lahore (* Parker 7883 !, 7875 !).
Flowers.—August.
* A weed in the Government gardens.
Distribution.—Arabia; Tropical Africa. India—N.-W. Provinces, Sind, Punjab, Rajputana.

107. **Abutilon fruticosum** Guill. & Perr. Seneg. I, 73.

Locality.—Changa Manga (Parker 7886 !); Gurdaspur (Drum. 4630 !); Rawalpindi—Futtehgunj (Ait. 345 !).
Flowers.—August-November.
Distribution.—Tropical Africa; Arabia; Baluchistan; Java. India—Sind, Rajputana.

108. **Abutilon molle** Sweet Hort. Brit. ed. II, 65.

Locality.—Lahore (* 31 !).
* Beginning to run wild.
Distribution.—Peru.

58. Urena *L.*

109. **Urena lobata** L.

Locality.—Hoshiarpur (Ait. 505 !).
Distribution.—Tropics of both hemispheres. Generally distributed over the hotter parts of India.

59. Pavonia *CAV.*

110. **Pavonia** near **P. hastata** Cav. of S. America & Australia.

Locality.—Lahore—Gardens (6770 !).
Flowers.—December. Flowers white with a crimson centre.

60. Hibiscus *MEDIK.*

111. **Hibiscus Solandra** L 'Hér. Stirp. I, 103, t. 49.

Locality.—Dalhousie (Drum. 154 !).
Distribution.—E. Tropical Africa. Hotter parts of India, from the N.-W. Provinces to Sikkim, and from Kumaon and Burma to Ceylon.

112. **Hibiscus vitifolius** L.

Locality.—Lahore—Changa Manga (Parker 40714 !, 40715 !); Lahore Gardens (Parker 14864 !).
Flowers.—October-November.
Distribution.—Tropical Africa; Australia. Hotter parts of India from the N.-W. Provinces to Ceylon.

113. **Hibiscus cannabinus** L.

Locality.—Lahore (Stewart 2847 !).
Distribution.—Cultivated in most tropical countries. India—generally cutivated, apparently wild east of the Northern Ghats.

114. **Hibiscus Gibsoni** Stocks. Mss.

Locality.—Rawalpindi—Barrakow to Triete (Ait. 346 !).
Flowers.—September.
Distribution.—Afghanistan; S. Tropical Africa; N. Australia. India—Punjab, Sind, Deccan, Konkan.

115. **Hibiscus ficulneus** L. Sp. Pl. 695.

Locality.—Rawalpindi (Ait. 178 !).
Distribution.—Asia; Tropical Australia.

116. **Hibiscus tiliaceus** L.

Locality.—Lahore—Gardens (Parker 12961 !).
Flowers.—April.
Distribution.—Tropics of both hemispheres, usually near the coasts. India—Coasts of both Peninsulas, Bengal and Ceylon.

117. **Hibiscus Rosa-sinensis** L.

Locality.—Peshawar College (Quizilbash 57 !).
Distribution.—Cultivated in gardens throughout India.

118. **Hibiscus argentinus** Speg. in Bot. Agric. Buenos Aires I, 304.

Locality.—Lahore—Gardens (Parker 17190 !).
Flowers.—June.
Distribution.—Argentine.

61. Thespesia *CORR.*

119. **Thespesia populnea** Corr. in Ann. IX, p. 290.

Locality.—Punjab (Ait. 633 !).
Distribution.—Tropical Asia, the Pacific Islands; Africa. Tropical shores of Bengal, Ceylon and both Peninsulas.

62. KYDIA *ROXB.*

120. **Kydia calycina** Roxb. Hort. Beng. 50.

Locality.—Rawalpindi—Triete (Ait. 348 !).
Flowers.—September.
Distribution.—India—Tropical regions of the Himalaya, from Kumaon eastwards, and throughout the Western Ghats.

63. CHORISIA *H. B. & K.*

121. **Chorisia insignis** H. B. & K. Nov. Gen. & Sp. V, t. 485, f. 1.

Locality.—Lahore—Gardens (Parker 38856 !, 37123 !).
Flowers.—January.
Distribution.—Peru.

XXIV. STERCULIACEAE.

64. STERCULIA *L.*

122. **Sterculia diversifolia** G. Don Gen. Syst. I, 516.

Locality.—Lahore—Gardens (Parker 13795 !, 12950 !, 12951 !).
Flowers.—April ; *Fruits.*—May.
Distribution.—Australia.

65. HERITIERA *AITON.*

123. **Heritiera macrophylla** Wall. ex. Voigt. Hort. Suburb. Calc. 103, nomen and ex Kurz, in Journ. As. Soc. Beng. XLII (1873), II, 61.

Locality.—Lahore—Gardens (Parker 14390 !).
Flowers.—May.
Distribution.—India ; Burma.

66. HELICTERES *L.*

124. **Helicteres Isora** L.

Locality.—Rawalpindi—Barrakow (Ait. 179 !).
Flowers and Fruits.—September.
Distribution.—Java ; N. Australia. Dry forests throughout Central and Western India, from Bihar, as far west as Jammu, the Western Peninsula and Ceylon.

XXV. TILIACEAE.

67. GREWIA *L.*

125. **Grewia oppositifolia** Roxb. Fl. Ind. II, 583.

Locality.—Rawalpindi (Parker 22416 !) ; Hoshiarpur (Ait. 273 !) ; Kangra (alt. 3000).
Flowers and Fruits.—October-February.
Distribution.—India—Common and indigenous, wild in the N.-W. Himalaya; from Jammu to Nepal, ascending to 7,000 ft. ; also frequently cultivated.

126. **Grewia populifolia** Vahl.

Locality.—Rawalpindi (Ait. 352 !, 198 !) ; Hissar (Duthie 3881 !).
Flowers.—August.
Distribution.—Afghanistan ; Baluchistan ; Arabia ; Tropical Africa ; Mauritius. India—Punjab, Rajputana, Sind, W. Peninsula, Nilgiris, Konkan,

127. **Grewia salvifolia** Heyne in Roth Nov. Sp. 239.

Locality.—Rawalpindi (Parker 22415 ! ; Ait. 180 !).
Fruits.—September-December.
Disrtibution.—Tropical Africa. India—N.-W. Provinces, Rajputana, Sind, W. Peninsula.

128. **Grewia sapida** Roxb. Fl. Ind. II 590.

Locality.—Rawalpindi—alt. 3500 (Jerrum 7328 !).
Distribution.—India—tropical Himalaya, from Gharwal to Bhotan and Assam.

129. **Grewia flavescens** Juss. in Ann. Mus. Par. IV (1804) 91 = pilosa.

Locality.—Lahore—Gardens (* Parker 13793 !).
Flowers.—September.
* Grown from seed collected in Jaipur State.
Distribution.—Tropical Africa.

68. Corchorus *L.*

130. **Corchorus trilocularis** L. Mant (1767) 529.

Locality.—Rawalpindi—Fattehganj (Ait. 350 !, 351 !) ; Hissar (Duthie 3885 !) ; Lahore (Stewart 2830 !, 2957 !, 2986 !).
Fruits.—August-September.
Distribution.—Tropical Africa ; Afghanistan. India—N.-W. Provinces, from Ambala to the Punjab, Rajputana, Sind, Nilgiri Hills.

131. **Corchorus Antichorus** Raesch. Nomencl. Bot. ed. III, 158.

Vern. N. *Biphali.*
Locality.—Lahore—(Cleghorn 2643 ! ; Changa Manga 42604) ; * Multan (27 ! ; Ait ! ; Munro 234 !) ; Hissar (Harsukh 20683 !, 20685 !) ; Lyallpur (Inayat !).
Fruits.—September-December.
* Used as medicine to produce cold in the body. Fodder for goats only but not very good.
Distribution.—Afghanistan ; Aden ; Tropical Africa ; Cape de Verde Isles. India—N.-W. Provinces, Rajputana, Sind, Western Peninsula, in Kathiawar, Gujarat, the Deccan.

132. **Corchorus acutangulus** Lam. Encycl II (1786) 104.

Locality.—Rawalpindi (Ait 179 !).
Flowers.—September.
Distribution.—Australia ; Tropical Africa ; West Indies. India—Rajputana, Sind and hotter parts ; Ceylon.

69. Tilia *L.*

133. **Tilia vulgaris** Hayne Arzn. Gew. III, t. 47.

Locality.—Kangra (Trevar 14395 !).
Distribution.—Europe.

134. **Tilia cordata** Mill. Gard. Dict. ed. VIII. n. 1.

Locality.—Between Kata top and Dalhousie alt. 7000 (Parker* 21653 !).
Flowers.—June.
* Several specimens growing wild on the northern slope.
Distribution.—Europe.

XXVI. LINACEAE.

70. LINUM *L.*

135. **Linum strictum** L. Sp. Pl. 279.

Locality.—Rawalpindi (Ait. 353 !).
Flowers.—May.
Distribution.—Mediterranean region ; Orient.

XXVII. MALPIGHIACEAE.

71. GALPHIMIA *CAV.*

136. **Galphimia gracilis** Bartl. in Linnea, XIII (1839) 552.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38775 !, 38774 !).
Flowers.—August.
Distribution.—Mexico.

72. STIGMAPHYLLON *A. JUSS.*

137. **Stigmaphyllon periplocæfolium** A Juss. in Arch. Mus. Par. III (1843) 380.

Locality.—Lahore—Gardens (Parker 12976 !).
Flowers.—April.
Distribution.—Western India.

73. HIPTAGE *GAERNTN.*

138. **Hiptage Madablota** Gaertn. Fruct. II, 169, t. 116.

Locality.—Hoshiarpur (Ait. 600).
Distribution.—China ; Java. Throughout the hotter parts of India, from Jammu and Sind to Burma, Malacca and Ceylon.

XXVIII ZYGOPHYLLACEAE.

74. TRIBULUS *L.*

139. **Tribulus terrestris** L. Sp. Pl. (1753) 387.

Locality.—Lahore (Stewart 2679 !) ; (Cleghorn 2653 !) ; Hissar (Duthie 3887 a !) ; Multan (Monro 32 !) ; Rawalpindi (Ait. 355 !).
Flowers.—April-October.
Distribution.—Throughout the warm regions of the globe. Throughout India.

140. **Tribulus alatus** Del. Fl. Aegypt. Arab. III (1812) 62.

Locality.—Multan (Monro 196 !).
Distribution.—Egypt ; Arabia ; Nubia. India—Rajputana, Sind, Punjab.

75. FAGONIA *L.*

141. **Fagonia arabica** L.

Locality.—Jullandar-Phillur (Parker 8152 !) ; Peshawar College (Quizilbash !).
Flowers.—February.
Distribution.—Throughout N.-W. India, Sind, the Punjab and the southern provinces of the Western Peninsula. Westwards to Egypt.

XXIX GERANIACEAE.

76. MONSONIA *L.*

142. **Monsonia heliotropioides** Cav.

Locality.—Multan (Duthie 10795 ! ; Monro !).

Flowers.—December.
Distribution.—India—the Punjab, Rajputana, Sind. Westwards to Egypt.

77. GERANIUM *L.*

143. **Geranium rotundifolium** L.

Locality.—Rawalpindi—Barrakow & Hissar (Ait. 357 !); Hoshiarpur (Ait. 250 !).
Distribution.—India—the Punjab and W. Temp. Himalaya. Siberia and eastwadrs to Europe and N. Africa.

78. OXALIS *L.*

144. **Oxalis corniculata** L. Sp. Pl.

Locality.—Rawalpindi—Barrakow (Ait 358 !); Lahore (Stewart 2835 !).
Flowers.—April.
Distribution.—Cosmopolitan. Throughout the warmer parts of India and Ceylon, ascending the Himalaya to 700 ft.

145. **Oxalis corymbosa** DC. Prod. I, 696.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 21215 !); Lahore (Parker 21216 !).
Flowers.—February. Pink.
* Naturalized in moist shady places. Completely naturalized.
Distribution.—Madagascar.

146. **Oxalis latifolia** H. B. K. Nov. Gen. et. Sp. V, 237. t, 467.

Locality.—Punjab plains in irrigated places (Parker 19504 !).
Flowers.—July.
Distribution.—Mexico.

147. **Oxalis Pes-caprae** L. Sp. Pl. 434.

Locality.—Lahore (* Parker 21217 !, 21218 !).
Flowers.—March; Yellow.
* Quite naturalized in moist places. Sometimes cultivated with double flowers.
Distribution.—S. Africa.

79. AVERRHOA *L.*

148. **Averrhoa Carambola** L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13613 !); Hoshiarpur (* Ait, !).
Flowers.—June.
* Cultivated tree.
Distribution.—In gardens throughout the hotter parts of India as far north as Lahore. Native country unknown.

XXX. RUTACEAE.

80. RUTA *L.*

149. **Ruta graveolens** L.

Locality.—Rawalpindi (Ait. 354 !).
Flowers.—April.
Distribution.—Cultivated in India. Westwards to the Canaries.

81. PEGANUM *L.*

150. **Peganum Harmala** L.

Locality.—Rawalpindi (Ait. 359 !); Lahore (Cleghorn !; Stewart 2540 !).
Flowers.—April.

Distribution.—Soongaria; Arabia; N. Africa, and Westwards to Hungary and Spain. N.-W. India from Sind, the Punjab and the Kashmir plain to Delhi and Agra; Western Deccan.

82. ZANTHOXYLUM L.

151. **Zanthoxylum alatum** Roxb. Fl. Ind. III, 768.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 37193 !, ** 38635 !).
Flowers.—January—April.
** This is identical with a thornless form which is common in China (Duthie).
* Zanthoxlyum introduced from Argentina as *Fagara Coco* Engl. but apparently not that species.
Distribution.—Hot valleys of the subtropical Himalaya, ascending to 6,000 ft. from Jammu to Bhotan; Khasia Hills, 2-3,000 ft.

83. MURRAYA *L.*

152. **Murraya exotica** L.

Locality.—Hoshiarpur (Ait. 548 !); Hoshiarpur Siwaliks (Mardanali !).
Probably indigenous (Duthie).
Distribution.—Throughout the hotter parts of India from Gharwal to Assam and Burma, and southwards to Chittagong, Travancore and Ceylon. (Eastwards to China, Australia, and the Pacific Islands.

153. **Murraya Koenigii** Spreng. Syst. Veg. II, 315.

Locality.—Peshawar (Quizilbash 4856 !).
Distribution.—Along the foot of the Himalaya, from Gharwal to Sikkim, ascending to 5,000 ft.; Bengal, Pegu and southwards to Travancore and Ceylon. Often cultivated.

84. LIMONIA *L.*

154. **Limonia acidissima** L.

Locality.—Kotla 37963 !; Hoshiarpur (Ait. 416 !).
Flowers.—April.
Distribution.—Yunnan.. Dry hills in various parts of India, N.-W. Himalaya in Simla and Kumaon, ascending to 4,000 ft.; Monghyr hills in Bihar; Assam; Western Peninsula, from the Bombay Ghats and Coromandel southwards.

85. AEGLE *CORR.*

155. **Aegle Marmelos** Correa.

Locality.—Hoshiarpur (* Ait. 520 !).
* Quite wild.
Distribution.—Throughout India; wild or cultivated, ascending to 4,000 ft. in the W. Himalaya.

XXXI. OCHNACEAE.

86. OCHNA *L.*

156. **Ochna squarrosa** Roxb.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13141 !, 13643 !).
Flowers.—May.
Distribution.—India—Silhet; Burma; E. and W. Peninsulas, and Ceylon.

XXXII. BURSERACEAE.

87. Bursera *L.*

157. **Bursera serrata** Wall. Cat. 8492.

Locality.—Lahore—Gardens (*Parker 6115 !).
Flowers.—April.
* Cultivated.
Distribution.—India—E. Bengal; Garo Hills and Rajmahal Hills, Assam; and Chittagong.

XXXIII. MELIACEAE.

88. Melia *L.*

158. **Melia Azedarach** L.

Locality.—Rawalpindi (Ait. 360 !).
Flowers.—April.
Distribution.—Persia; China. Commonly cultivated in India; wild in the sub-Himalayan tract, alt. 2-3,000 ft.

89. Chikrassia *JUSS.*

159. **Chikrassia tabularis** A. Juss. in Mem. Mus. XIX 251, t. 22, f. 27.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14371 !, 14370 !, 14369 !).
Flowers.—April; Pale yellow.
Distribution.—India—W. Peninsula from the Konkan to Coorg. Malacca and Ceylon.

90. Cedrela *L.*

160. **Cedrela Toona** Roxb. ex Rottl. & Willd. in Gesell. Nat. Freunde. N. Schr. IV, 198 (1803).

Locality.—Dalhousie (Drum. 206 !); Rawalpindi (* Ait.).
* Cultivated in Jhelum and Rawalpindi.
Distribution.—Java; Australia. India—tropical Himalaya; from the Indus eastwards ascending to 3,000 ft.; throughout the hilly districts of Central and S. India and Burma.

XXXIV. OLACACEAE.

91. Olax *L.*

161. **Olax nana** Wall. Cat. 6783 A.B.

Locality.—Hoshiarpur (* Ait. 467 !).
* On the sand storm rocks in clefts.
Distribution.—India—Hot valleys of the W. Himalaya, ascending to 5,000 ft. from Nepal westwards and in the Punjab.

XXXV. ILICACEAF.

92. Ilex *L.*

162. **Ilex Cassine** Walt. Fl. Carol. 241.

Locality.—Lahore—Gardens (Parker 6260 !).
Flowers.—April.
Distribution.—N. America.

XXXVI. CELASTRACEAE.

93. Euonymus *L.*

163. **Euonymus pendulus** Wall. in Roxb. Fl. Ind. ed. Carey, II, 406; Cat. 4280.

var. *japonicus* L.
Locality.—Lahore—Ag. Hort. Gdns. (Parker 13652 !).
Flowers.—May.
Distribution.—India—temperate Himalaya.

164. **Euonymus Hamiltonianus** Wall. in Roxb. Fl. Ind. ed. Carey, II, 403; Cat. 4279.

Locality.—Rawalpindi alt. 6,000 ft. (Jerram 8063 !).
Distribution.—India—temperate Himalaya.

165. **Euonymus japonicus** L. f. Suppl. 154.

Locality.—Peshawar (*Quizilbash 61 !).
* Cultivated.
Distribution.—China; Japan.

94. Celastrus.

166. **Celastrus paniculata** Willd. Sp. Pl. I, 1125.

Locality.—Hoshiarpur (Ait. 564 !); Gurdaspur—Dhunera (Bisram 309 !).
Distribution.—Tropical and subtropical Himalaya alt. 1-4,000 ft.; Punjab and throughout the hilly districts of India ascending to 3,000 ft. Ceylon; Malay Archipelago and Philippine Islands.

167. **Celastrus Royleanus** Wall. = **Gymnosporia Royleana** Wall.

Locality.—Hoshiarpur (Ait. 40 !); Rawalpindi-Fattehgunj (Ait. 1030 !); Gurdaspur (Bisram 53264 !).
Flowers.—March.
Distribution.—Afghanistan. India—W. Himalaya, in Kumaon and Gharwal, alt. 1-4,500 ft.

95. Elaeodendron *JACQ. f.*

168. **Elaeodendron glaucum** Pers. Synops. I, 241.

Locality.—Rawalpindi (Parker 7102 !); Kangra (Parker 7096 !); Hoshiarpur (Ait. 545 !).
Fruits.—June.
Distribution.—Malay Archipelago. Throughout the hotter parts of India and Ceylon.

169. **Elaeodendron orientale** Jacq. IC. Rar. t. 48.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 38697 !).
Flowers.—May.
* A small tree 15 ft. high, but has been frozen many times. Has much the appearance of a *Podocarpus*, but is one of the Celastraceae. Ovary confluent with disk. One cell distinct with 2 erect collateral ovules, and possibly 1 or 2 empty cells as well, but this is obscure.
Distribution.—Mauritius; Madagascar.

XXXVII. RHAMNACEAE.

96. Zizyphus *JUSS.*

170. **Zizyphus Jujuba** Lamk. Dict. III 318.

Locality.—Hoshiarpur (Ait. 105 !); Rawalpindi (Ait. 110); Hissar (Duthie 3908 !); Gurdaspur—Dhunera (Bisram 310 !).

Flowers.—June-July-August.

Distribution.—Ceylon; Afghanistan; China; Australia; Africa. Throughout India.

171. **Zizyphus hysudricus** Hole, in Indian Forester, 1918, XLIV, 505: *Z. Jujuba*, var. *hysudricus* Edgew.

Locality.—Lahore (Gamble 23383!; Parker 21205!); Changa Manga (* Parker 21206!, 20991!, 21204!); Ag. Hort. Gdns. (* * Parker 20992!, 21207!).

Flowers.—August-September; *Fruits.*—March.

* Cultivated form, fruits ovoid. It is budded on to the globose fruited wild form of the same species.

** Petioles long, l. glabrous, or glabrescent below. Wild form reaches 10 ft. in girth.

Distribution.—India—Rawalpindi, Ajmer, D. Ismail Khan, Lahore.

172. **Zizyphus Spina-Christi** Willd. Sp. Pl. I, 1105.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 24053!, 24054!).

Fruits.—December.

* Cultivated in Government Ag. Hort. Gardens, Lahore, from seed obtained from the Ag. Hort. Depart. Cairo, Egypt.

Distribution.—N. Africa; Orient.

173. **Zizyphus vulgaris** Lamk. Dict. III, 316.

Locality.—Rawalpindi alt. 4,500 ft. (Jerram 8065!).

Flowers.—June.

Distribution.—Baluchistan; W. Asia; China; Japan; South Europe; India.

174. **Zizyphus oxyphylla** Edgew. in Trans. Linn. Soc. XX, 43.

Locality.—Rawalpindi (Ait. 144!).

Distribution.—India.

97. Rhamnus *L.*

175. **Rhamnus persicus.** Boiss. Fl. Orient II, 17.

Locality.—Rawalpindi-Nandkot 4,000 ft. (Jaram 2266!, 7899!).

Flowers.—May.

Distribution.—Baluchistan; Persia, India.

176. **Rhamnus virgatus** Roxb. Hort. Beng. 17 (1814), nomen.

Locality.—Lahore—Gardens (Parker 8149!); Rawalpindi alt. 5,500-7,000 (Jerram 7900!).

Flowers.—April.

Distribution.—Nepal.

177. **Rhamnus triqueter** Wall. in Roxb. Fl. Ind. ed. Carey II, 376.

Locality.—Dalhousie (Drum. 4832!).

Distribution.—India—Punjab in the Salt Range; West Himalaya, from Jhelum to Kumaon.

178. **Rhamnus pentapomica** Parker in Kew Bull. 1921, 216.

Locality.—Rawalpindi—Futtehgunj (Ait. 1036!).

Flowers.—March.

Distribution.—N.-W. India.

98. Sageretia *BRONGN.*

179. **Sageretia Brandrethiana** Aitch. in Journ. Soc. VII, 62.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38781!); Rawalpindi—Futteh-gunj (Ait. 361!); Rawalpindi—Hissand (Ait. 1035!).

Flowers.—February-August.
Distribution.—Westwards to Persia and Arabia. India—N.-W. Provinces.

99. HELINUS *E. MEYER.*

180. **Helinus lanceolatus** Brandis For. Fl. 574. *

Locality.—Kangra—Dhamtal (7100 !).
Flowers.—July.
Distribution.—India—the Punjab, Oudh and the W. Himalaya from Kashmir to Kumaon, alt. 1-4,000 ft.

XXXVIII VITACEAE.

100. VITIS *L.*

181. **Vitis Jacquemontii** Parker, Forest Fl. Pb., ed. 2, 559 (1924).

Locality.—Rawalpindi 4300 (Jerram 8083 !); Dalhousie (Drum. 226 !).
Distribution.—E. India; China.

182 **Vitis trifolia** L. Sp. 203 = *V. carnosa* Wall. Cat. 6018. Vern. N. *Ratan bail.*

Locality.—Hoshiarpur (Ait. 211 !); Rawalpindi (Ait. 183 !); Hissar (* Cooper 3912 !; * * Duthie 3912 !).
Flowers.—September.
* Bulbous creeper. Largely applied to indolent swellings and promotes suppuration. Applied to anthrax with good results (from the letter of Dr. J. A. Cooper, Civil Surgeon).
* * Root said to be a remedy for carbuncles.
Distribution.—Tropical Himalaya, and throughout hotter parts of India from the Punjab and Burma to Ceylon and Malacca.

183. **Vitis arborea** L. Sp. Pl. 203.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38779 !).
Flowers.—August.
Distribution.—Orient; N. America.

XXXIX. SAPINDACEAE.

101. CARDIOSPERMUM *L.*

184. **Cardiospermum Halicacabum** L. Sp. Pl. ed. I, 366.

Locality.—Hissar (Duthie 3915 !).
Flowers.—August.
Distribution.—Most tropical and subtropical countries. Throughout India.

102. NEPHELIUM *L.*

185. **Nephelium tomentosum** G. Muell. in Trans. Vict. Inst. II (1858) 64.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 37126 !, 37125 !, 37124 !).
Flowers, Fruits.—January.
Distribution.—Australia.

103. ACER *TOURNEF.*

186. **Acer pentamopicum** J. L. Stewart ex Brandis For. Fl. 111.

Locality.—Rawalpindi—Gainthal, alt. 2,500 ft. (12979 !; Jerram 8497 ! alt. 1800-3500 ft.).
Flowers.—April-July.
Distribution.—India—N.-W. temperate Himalaya.

104. Dodonaea *L.*

187. **Dodonaea viscosa** L. Mant. Pl. alt. 228.

Localiy.—Rawalpindi (Ait. 1031 !); Hoshiarpur (51 !).
Flowers.—February-March.
Distribution.—Throughout India. Baluchistan; Ceylon and in all warm countries.

188. **Dodonaea triquetra** Andr.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11533 !, 13775 !, *12963 !).
Flowers.—February; bisexual.

* Grown from seed obtained in 1913 from Vilmorin under the above name. Resembles *D. viscosa* very closely but is monoecious. J. H. Maider, Sydney S. S. W. says 'appears to be referable to *D. viscosa* L.'

105. Staphylea *L.*

189. **Staphylea Emodi** Wall. Cat. 4275.

Locality.—Rawalpindi (Jerram 8271 !; over 6,000 ft. 8270 !).
Flowers.—July.
Distribution.—Afghanistan. India.

BURMA'S DECREASING WILD LIFE.

BY

D'ARCY WEATHERBE.

(*With two plates*).

INTRODUCTION.

Were it possible to prepare a careful chronological record, covering the past 50 years, from all available reliable sources, including big-game hunting and shooting records, in countries of the Empire, indicating the quantity of game existing, the results would be of intense interest and value. They would disclose in all countries such an appalling decrease in the stocks of wild animals remaining, that the figures would be startling in the extreme.

Returning recently from eighteen months in the Far East, which included long tours in Burma proper, the Southern and Northern Shan States, the 'Tribal' and 'Backward' areas, Manipur and Assam, and a special inspection of the Kahilu Rhinoceros Sanctuary in Lower Burma, my attention was drawn to a letter from Mr. A. W. Moodie, Chief Conservator of Forests, Burma, in June in at least two magazines. The letter calls attention to certain articles in the Press during the past two years, which deplored the inadequacy of measures for Wild Life Preservation in Burma. Mr. Moodie commends to those interested in the subject the Annual Reports of the Game Warden, which reports, he infers, should dispel any doubt as to the efficacy of such measures.

In further support of his contentions that these measures are adequate, Mr. Moodie gives details of the sanctuaries set apart in Burma for the purpose, and emphasizes that 'a whole-time' Game Warden is in charge of this work. Incidentally he points out that the Reports may be obtained at the offices of the High Commissioner for India in Aldwych, or through any bookseller. Inquiry at the offices mentioned, elicited the information that no Reports of the Game Warden, Burma had been received since 1935-36. Of a number of booksellers visited, none knew anything of a later report and the office of the King's Printer in Kingsway was equally ignorant. I have, however, beside me, a copy of the 1935-36 Report and a condensed copy of the Report for 1938, published in the *Rangoon Times* on January 21, 1939. The quotations which I use below are from these two sources, and they do not support Mr. Moodie's views.

With some claim to a knowledge of the subject, it is, in my opinion, important at this time that the present position should not be glossed over; to pose that everything in the garden is lovely in Burma's measures for wild life preservation would be fatal. In reality, as I attempt to show below, the reverse is the case, the garden is choked with weeds, and until more drastic efforts

Photo: D'Arcy Weatherbe.

Thamin or Brow-antlered Deer (*Rucervus thamin* Thos.).

A fast disappearing species in Burma.

are made to save species, now in immediate danger of extinction, agitation for reforms must not be slackened, and the necessity for criticism of the apathy that pervades must not be forgotten.

As one who is keenly interested in the conservation of wild life, who has given the greater part of his time during the past ten years or more in visiting and living in the great game areas of the world, in studying the question from a practical angle, and who at intervals has travelled widely in Burma during the past eighteen years, I cannot share Mr. Moodie's complacency. I am, in fact, surprised that one who should be conversant with the real conditions has adopted a view which so many of the facts contradict.

If the Chief Conservator's letter is merely a defence of his Game Warden and his administration it is intelligible.

Personally I have not the slightest doubt that most of these men have their hearts in their work and have tried with inadequate facilities to carry out what, to some of them at least, must have been a heartbreaking task.

Burma's Wild Life Sanctuaries.

I would like to draw brief attention to some of the instances that Mr. Moodie cites, rather unfortunately I think, as evidence of the result of adequate measures.

I will not refer in any detail to the show-piece of the Department, the Pidaung Reserve, except to remark that it appears to fulfil its functions. But like all other sanctuaries in Burma it is not under a Trust, and like the other reserves is liable to molestation, or even cancellation, on commercial or political grounds, by the present or future administration. In the Game Preservation Report for 1936, the Game Warden writes:—

> '. . . much depends, however, on the formation of a National Trust to take over the administration of sanctuaries . . . It is thought, therefore, that the formation of a National Trust for sanctuaries will be closely bound up with a Wild Life Protection Society, and the formation of a National Trust should be pressed forward with all speed.'

That was written some three years ago by the present Game Warden. Up to the present nothing whatever has been done to bring this about. The Game Warden's recommendation cannot be too strongly endorsed, as the danger of commercial or political exploitation hangs like the Sword of Damocles over these Sanctuaries.

A friend, a former high official and head of a department of the Government of India, in Burma, recently answering a protest of the writer, wrote as follows:—'If they cannot keep their National Parks inviolate in Malaya how can one expect any better behaviour in the case of a popular Government depending on the vote?' How indeed! Wild life have no votes.

He referred, of course, to the recent threat, by the present Administration in Malaya, to violate, for commercial purposes part of the King George V National Park. The attempt was, temporarily at least, frustrated by the matter being brought up strongly

in the House of Commons—but that for the present is another story.

Mr. Moodie writes:—'The Shwe-u-Daung Sanctuary was constituted primarily for the protection of the Sumatran Rhinoceros, but it also contains a good stock of elephant, bison, saing, sambhur, serow, barking deer, tiger, leopard, bear, pig and birds.'

In the condensed Game Warden's Report for 1938, mentioned above, the Game Warden is quoted:—'The Principal Forest Officer estimates *at least five* rhino in the Sanctuary but *no young* . . it is a very dangerous probability that young rhino are being killed off by tigers.' No mention is made of any other animals in the Sanctuary except sambhur, tiger and pig. 'Sambhur were reported to be less numerous.' The Game Warden mentioned that steps were being taken to *reduce* the number of tigers. In the Divisional Forest Officer's Report for 1936, though he saw sambhur he writes that 'no other animals were seen', and in several visits by the Principal Forest Officer and at least two other Forest Officers no mention is recorded of bison, saing or serau. The Divisional Forest Officer reports that poaching undoubtedly takes place in the western side of this Sanctuary, which the Game Warden had apparently not visited in 1938. Not a very inspiring outlook?

Of the Kahilu Sanctuary, the Chief Conservator writes:—'Contains a few specimens of Rhinoceros which are, according to all *available evidence,* the Javan Rhinoceros. It also contains sambhur, barking deer, bison, pig and game birds.' The underlining is mine.

It is quite incorrect to say that *all* available evidence shows these rhino to be *Rhinoceros sondaicus*. The writer visited and carefully inspected this Sanctuary in 1938 with the special object of trying to gather evidence as to the identity of the rhinoceroses there. A detailed report of this visit was submitted to the Forest Department in the same year, and the opinion was expressed that the identity of species of the specimens there was not definitely proved. This opinion took into account all evidence both pro and con which had been gathered up to that date and has been concurred in by at least two well-known experts on the subject, one of whom goes so far as to say that he did not think the animals there were of the Javan species and that the photographs of the tracks were almost positively of *sumatranus*.

In the same report I expressed the opinion that measures for the proper conservation and propagation of the few rhinoceroses there, whichever of the two species they may be, are totally lacking.

Regarding bison. So far as I could gather, they do not inhabit the Sanctuary, seldom visit it, and are rare in these parts. I saw tracks in two places only, probably of the same animal. Sambhur are not plentiful and game birds scarce, and as all game may be legally killed by villagers, on the pretext of necessity for crop protection, and as villagers live in the Sanctuary and have dogs and guns, it is morally certain that birds and small game are regularly poached. At least one Forest Officer has advocated that the natives be allowed to kill pigs without licences, though the

Serow (*Capricornis sumatrensis*).

Another animal which should be carefully conserved.

two rangers in the Sanctuary would be available for such protection if it was really necessary. Also it is absurd that constant cultivation should be practised in a 'sanctuary'. As my report on this area has appeared elsewhere (*B.N.H.S's Journal,* 1939) it is unnecessary to enlarge further on its deficiencies as a sanctuary.

Of the other sanctuaries, most of which are quite unimportant from the point of view of saving the fauna of the country, I will only comment on Mr. Moodie's reference to the MULAYIT SANCTUARY. He writes in *The Field* as follows:—'It contains chiefly bison, serow and mouse deer.' In the case of all of these sanctuaries to mention species particularly, one would be led to believe that they contained at least a fair and not easily exhaustible breeding stock of the animals for which they were set aside? Of this Sanctuary, the MULAYIT, however, the Game Warden writes in his report for 1938:—'The report of a subordinate, *specially deputed* to compile an estimate of the stock of wild animals here, is most disappointing. *No traces of any big-game animals were seen.* Wild dogs were the only animals encountered.'

SHAN STATES.

Referring to these States the Game Warden's report for 1938 says:—'Legislation to provide protection would be almost valueless, considering the vast area of unclassed forest and the small number of Forest subordinates available.' And again:—'The Divisional Forest Officer, Northern Shan States, reports that jungle fowl appear to become scarcer every year,' and he adds 'it is not surprising in view of the energy with which local villagers hunt them down, wherever they are found, and so-called sportsmen cannot be said to be blameless in this matter. He might have truly said, further, that they are destroyed in and out of season equally relentlessly.

In another place, referring to proposals for improvement of protective measures the Game Warden's report says:—'The Principal Forest Officer (Shan States) writes . . . one great stumbling block will always exist, however, in the number of guns licensed as there seems to be no hope of their reduction to anything approaching reasonable numbers.'

Well might he complain for, incredible as it may seem, the official number of licences for guns issued in the Shan States alone, to say nothing of the rest of Burma, was over 27,000. Without the srongest protective measures, what chance has wild life of survival under such conditions?

In the 1936 report, the Game Warden wrote:—'Throughout the Shan States a large number of offences against the Game Rules must be committed annually, but, with the very limited forest staff available, it is impossible to detect the majority of these offences,' and, in another paragraph of the same report we find:—'The Divisional Forest Officer, MONGMIT DIVISION, reports that saing have been severely depleted by epidemic, especially in NAUHLIANG RESERVE. This is most unfortunate, as the NAUHLIANG RESERVE and the surrounding unclassed forests used to be well stocked with these animals.'

No mention of investigations as to cause or possible amelioration is made, but presumably that would be impossible without increased staff or the calling on Government veterinary officers or other skilled advice.

After a recent tour in the Northern and Southern Shan States, covering in all upwards of 800 miles, the writer's impression was that over a great portion of the whole area most of the larger fauna may be considered as practically extinct.

There may be, however, extensive tracts more sparsely settled, where strict protective measures might still produce favourable results. If such measures are not instituted promptly, the first-mentioned condition will maintain over the whole area.

A glance at the financial figures for the Shan States for 1934-5-6,—I have no figures for 1938—will make serious consideration of any protection in the region appear farcical. The revenue for 1934-5 from wild life was Rs. 832 and in 1935-6 was Rs. 710, while for the same respective periods the expenditure was Rs. 70 and Rs. 25, the equivalent of £5-3-0 and £2-0-0. It might be of interest to know on what these sums were expended.

Many more instances of the admittedly unsatisfactory state of Wild Life Protection in Burma generally might be quoted, were it necessary; but a summary of the specific causes of such unsatisfactory conditions with a few notes thereon will suffice.

Insufficient Provision of Funds.

This is the primary cause and the one that must be remedied before any further reforms need be considered.

Although destructive criticism may correctly analyse and call attention to ills it may not be very useful unless practical remedial suggestions are also given.

In Burma's case it may be thought that it is too late. That is a defeatist policy and not one to which I can subscribe. With regard to some of the fauna, determined and drastic measures may be necessary. Notably amongst species possibly doomed to early extinction in Burma is the Rhinoceros, followed by the Thamin deer. In the latter case the quick and efficient development and administration of the sanctuaries now proposed for its survival may save it as a species. Outside these areas it will not last long under present conditions. In some districts where they formerly existed large bovines, bison and saing, are already extinct; in other districts they are fast becoming so; while in the Pidaung Reserve it is refreshing to note that so long as it is maintained as at present, *including its necessary extensions,* these two species should flourish there.

It is curious to note that the one species naturally maintaining its existence in Burma is the very one that is now threatened by official slaughter at the hands of those selected to support its preservation. I refer of course to the Elephant and 'Elephant Control'. I hope to have more to say on this question elsewhere.

Now I think that I can indicate where funds should come from and logically show how and why certain revenues should be allocated for the work of conservation.

In the summarized extracts of the Game Warden's Reports for 1938, now before me, no figures of revenue and expenditure are available, but for comparison I have used the figures for 1935 and 1936. They are enlightening, though insufficient in detail.

Under Wild Life Protection the figures are as follows:—

			1935	*1936*
			Rs.	Rs.
Revenue	...	...	38,189	38,758
Expenditure	...	...	3,445	10,350

In the last figure for expenditure the 'Elephant Control' figures are not included, while the sum of Rs. 1,211 is not included in the revenue, the proceeds from fines.

But the most important omission is the revenue from licences and import duties on sporting arms and ammunition, which the Game Warden roughly estimates as another lakh of rupees. (Rs. 100,000).

It is not stated whether fees for export permits on trophies and wild life specimens are included but with a properly organized Game Department there is little doubt that on the present figures an approximate revenue from Wild Life Resources would amount to perhaps Rs. 150,000, which should be made available for conservation.

From what I have written above it must be obvious that without reforms and funds it is a matter of time only when no further expenditure on Wild Life Protection will be required—there will be nothing to protect.

Judging by the past, the period before we reach that condition will be short indeed, but before reaching it the revenue from wild life resources will also have disappeared. These implications are simple but will they be believed? The first question to be asked is:—Would a properly organized and independent department, with sufficient funds at its disposal, be able to save the majority of species holding their own and possibly resuscitate others now in danger? I think so, if present conditions are not allowed to drag on, and reforms *completed* within a couple of years at the most, though a few changes should be made immediately.

Outside the sanctuaries matters are in a critical state; inside them, bar the Pidaung Reserve, most unsatisfactory. If the Government of Burma are not satisfied that conditions are as represented above, then let them appoint an expert, but completely independent commission to inquire into the whole subject. Official findings, however disinterested, will never secure the complete confidence of the outside world. Let the work of inquiry be as competent and thorough as was that of the Wild Life Commission in Malaya, but for the sake of Wild Life Conservation, and for the reputation of the Burma Government, do not let the recommendations be ignored and wasted as were those in Malaya.

The above facts summarized are as follows:—

(*a*) There is an annual income from Wild Life Resources now being collected in Burma amounting to between Rs. 100,000 and 150,000.

(*b*) This income is derived solely through the existence of Wild Life.

(*c*) Wild Life is diminishing rapidly. Long before it is actually finished the greater part of the income from these resources will cease.

(*d*) The Wild Life, or a considerable portion of it, it is thought, if adequate measures are taken now, can be saved, and the income maintained. To do this the greater part of the income must be expended for the purpose to which it obviously belongs.

This principle is well recognized in countries that have looked the question in the face and successfully tackled it.

The reasons why the Burma Government has not done so must be put down to ignorance, disbelief or apathy, and the greatest of these is apathy.

An Unscientific and Compromising System forming the Present Machinery for the Administration of the Game Laws and other Measures for Wild Life Protection.

This heading refers to the fact that the administration at present is entirely under the Forest Department.

This antiquated system is a relic of the Government of India's jurisdiction over Burma during which the greater part of the wild life of both India and Burma has disappeared, and though this, perhaps, may be partly due to parsimony, until quite recently it was due to indifference to and lack of knowledge by the Forest Department of that branch of its work.

One of the chief reasons for the employment of the Forest Department for the protection of wild life was economy and, judging by results, a false economy; if we are to agree that the same serious considerations are to be given to this national possession as to others more definitely commercial.

The work of the Forest Department is essentially utilitarian and commercial. Where its immediate objects may conflict with the principles and practice of wild life protection, and they may so conflict in a number of cases, the interests of the former would prevail.

The use of the Forest Department is a makeshift, and its personnel, *per se,* is little if any better fitted for the duties of wild life protection than are members of a number of other departments. In practice a number of Forest Officers are shooting men, but that in itself is not necessarily a qualification. It may be, I regret to say, and in some instances I have known it was, a detriment. Many Forest Officers have not, as might well be expected, any interest either in destruction or preservation of wild life. Such men may be, and upon occasions are, in charge of critical areas, in which are situated sanctuaries requiring special attention. Their attitude would naturally be one of indifference. To such men a voluntary policy of vigorous apprehension or prosecution of offenders could hardly be expected, even if they were allowed to spend their time on such duties.

On principle I think that the term 'whole-time' Game Warden a misnomer, when applied to Forest Officers transferred temporarily to this position. I believe I am correct in saying that since the first Game Warden was seconded from that service some eleven years ago, there have been four incumbents, but for four years of that time there was no official Game Warden at all. One of these officers has acted in that position in an honorary capacity *in addition to his official duties.*

The position is not altogether independent, and is not looked upon either as a career or as a permanent occupation. When promotion comes, and perhaps before, for one reason or another, the Game Warden reverts to his position as Conservator or whatever it may be in the Forest Department. If on leave another Forest Officer is temporarily appointed as Game Warden, but whether in addition to his other duties or not, I do not know. During his tenure of office a Game Warden has not control of other officers of his department who are supposed to be assisting him in duties. They are under their own departmental chiefs and naturally their routine forest duties have first call on their time. The Game Warden cannot give them orders at all.

The Chief Conservator of Forests is Head of the Department administrating preservation of wild life; but he has not reached the position of Chief Conservator through any special qualifications for that branch of his department's work and might not, in fact, have the slightest interest in or knowledge of the subject. It is he, however, who is responsible, and who has to deal with the appropriate Ministry—a most important function.

The Art of Conservation of Wild Life cannot be picked up in one's spare time.

There can hardly be two opinions but that the Wild Life Protection Departments of countries of the Empire, like India, Burma and Malaya, should be entirely divorced and separated from any other department, and while in every way gratefully accepting co-operation and assistance, a completely independent department must be responsible for the work of Conservation.

The Director of such a department should be a man of suitable age and selected for his technical ability for, and experience in, practical wild life eonservation, as well as his disinterested keenness in the work. In Burma, it is probable that such a man might be available from the Forest Department Service, could he be transferred from that department. But a separate department must be formed if success is to be obtained. We have sufficient proof of the failure of the present system.

Shortage in the number of Game Wardens, Game Rangers, Watchers, Guardians, etc.

At present there is only one Game Warden and whether he is 'whole-time' or not, it is physically impossible for him to properly visit or supervise his vast area in the six months season of the 'cold weather' during which time it is customary, and in some cases only possible, to travel in Burma.

It is a vast territory of forests, jungles, rivers, swamps and

mountains, sparsely traversed by roads or railways; and travelling off the beaten track is slow and arduous.

The area under the Game Warden, which contains some six sanctuaries, stretches north and south a thousand miles from above Myitkyina to Victoria Point, and from the China Border on the east to the Bay of Bengal and Assam on the west.

The Game Warden writes :—'In almost every Forest Division the Divisional Forest Officer admits that sufficient attention to wild life preservation cannot be given by the existing staff.' He further points out that during the year, while some 15,000 licences for sporting fire-arms were taken out, exclusive of the Shan States, only 721 of these licensees took out game licences. The inference is obvious. Further he writes:—'When it is realized that there are 31,300 square miles of Reserved Forests to which all of the Game Laws apply, and 92,000 square miles of Unclassed Forests to which many of the Game laws apply, the difficulty of controlling the activity of poachers with a limited staff can be appreciated.'

The Conservator of Forests in Sittang Circle who was the first Game Warden, and who afterwards acted in an honorary capacity, is quoted by the present Game Warden, in the 1938 report, as follows :—

Referring to South Toungoo and Pegu Divisions: 'In both these Divisions during the hot weather all the available staff is moved from the hill forests down to the plains in order to cope with the annually increasing amount of (forest) work . . . . the area in both these Divisions where game is most plentiful, or rather least scarce, are therefore left almost entirely unprotected during he period of the year in which protection is most needed.'

At the very minimum an additional two or three Game Wardens are urgently needed, whose duties should be in the field and not in an office, and who should be almost constantly touring the areas allotted to them. Although co-operation should maintain, as at present, with Forest Officers and subordinates in the field, a very much larger staff of permanently employed game rangers and other natives should be employed, and these should be under constant supervision of the Game Wardens. Watchers and others, who would be sources of information, in towns and villages, markets and fairs, should be regularly employed, and the police should be instructed to co-operate with them.

Honorary Game Wardens should be appointed wherever keen men could be induced to act, more especially in the game bird districts, where their assistance should prove invaluable.

There are, I feel sure from my own experience, many good sportsmen who would willingly act in this capacity. This branch of the conservation service is of great use in East Africa and it also was used in Malaya.

Lack of Comprehensive, Consistent and Practical Laws to Embrace the Conservation of Wild Life in all its Phases.

A law which would ensure facile provision for prompt legal apprehension, prosecution and punishment of all offenders against

its provisions giving, at the same time, wide powers to the Game Warden to enable him to carry out his work without irksome and time-wasting references, would go a long way to solve the problem which confronts wise conservation of wild life in Burma.

No such law is on the statute book in Burma today. Protection of Wild Life was embodied in the Forest Department Act, in the Burma Game Rules published under that Act, and in the Wild Birds and Animals Potection Act.

An attempt was made to better these provisions, and nearly three years ago a new act was drafted and called the 'Burma Wild Life Protection Bill, 1936.' At that time Burma was a Province of India, but before the draft with its rules was finally finished the inauguration of the new Burma Government became imminent. This draft was a move in the right direction and its promoters deserve considerable credit for what they achieved. It does not, however, fulfil the requirements of a complete law on the subject. Besides being inadequate it is in some respects inconsistent, and in one ludicrous. The provisions regarding rhinoceros prohibit the killing of the animal. In another clause, however, its blood may be legally sold by native medicine men and others though there is no special provision for killing it or importing it for this or any other purpose, except that there is one clause allowing the animal to be killed in protection of crops.

In fairness I should say that it was reliably stated to me that the reason it was submitted in this form was the urgency of getting it approved before the new and independent Legislature took office, as if not already approved the act might have been indefinitely delayed or not passed at all.

While I leave the reader to judge the value of this excuse, I would point out that the Rules for the Act had not been passed up to March 1938. So the Game Rules of 1927 are still being followed where they do not conflict with the provisions of the new Act.

The Inordinate Issue of Gun Licences for all Sorts of Unnecessary Reasons.

Although[1] the country is not at war there are over forty thousand licences issued for guns! For what purpose? These guns are not given to the police or to the armed forces, but to ordinary citizens. Such conditions are unknown elsewhere in the Empire. The populace should be disarmed and fire-arms only issued with the strictest supervision, and only for *bona fide* sporting purposes, and *in conjunction with game licences,* issued and renewable annually by the Game Warden alone.

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[1] Written before outbreak of war.

The Collection, Sale and Export of Wild Animals for Commercial Purposes.

This nefarious practice goes on, I believe, to a far greater extent than is perhaps supposed, and often upon the false plea that the animals are collected for scientific purposes. No animal should be captured or exported, except by special permit signed by the Game Warden himself, after the strictest inquiries as to the purpose. Co-operation of the police at all ports and elsewhere, to prevent the harbouring of wild animals or birds without permit, should be freely given, as also the good offices of the Customs Department to prevent illegal export. The lack of control is referred to in the Game Warden's Report for 1938.

His Majesty's Government has, I believe, on a number of occasions, through various Ministers, and through at least one Prime Minister, clearly enunciated that preservation of the wild fauna of the Empire was a policy that had its firmest support.

If, therefore, the suggestions I have made above fail with the Burma Government and with the Governor, then in that last resort persistent appeal must be carried to London. But through what organized channel is this appeal to be made? That is the difficulty.

In my view, though it is a depressing admission, until public opinion becomes sufficiently interested in the subject, none exists to-day that has practical influence.

Sayeedud-Din—*Allmania nodiflora* R.Br. (Nat. Size).

For explanation see end of article.

SOME COMMON INDIAN HERBS WITH NOTES ON THEIR ANATOMICAL CHARACTERS.

BY

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(*With two plates*).

(*Continued from page* 798 *of volume* xli, *No.* 4).

V.—ALLMANIA NODIFLORA R. Br.

(AMARANTACEAE).

SYNONYMY AND SYSTEMATIC DESCRIPTION.

Allmania nodiflora R. Br. (var. *aspera* Hook.) in Wall. Cat. 6890, excl. B; H. F. B. I., IV, 716; Gamble F. M. Pr., Pt. VII, 1167-1168; Syn:—*Chamissoa aspera,* Wt. Ic. t. 1772; *Celosia aspera* Roth Nov. Sp. 173.

An annual, diffusely dichotomously branched, sparsely hispidly hairy herb with stout root-stock. Leaves alternate, lanceolate. Flowers in large axillary and terminal globose brownish orange heads which consist of small dichasia, in each of which there are 3 flowers, the centre one sessile with 1 bracteole, the side ones pedicellate with 1 bract and 2 bracteoles; bracts and bracteoles narrow, scarious, hispid, with filiform tips. Perianth calycine, of 5 almost free lanceolate acuminate lobes. Stamens 5, filaments united in a membranous hypogynous cup, anthers 2-celled, opening by means of slits; pollen irregularly spherical and blackish when dry, round and brownish black when moistened. Ovary ovoid; ovule erect; style slender; stigma 2-lobed. Fruit an ovoid membranous utricle, circumscissly dehiscent. Seed erect, subglobose, in a cupular aril. (Plate I, & Pl. II, Fig. 4). Flowers practically throughout the year.

HABITAT.

Corn-fields, Coimbatore and Mysore (Hooker, 3); Deccan Districts, west to the E. slopes of the Ghats, less common in Circars or Carnatic, in fields (Gamble, 2); a common weed in Hyderabad Deccan, very variable (Sayeedud-Din, 7); Deccan: Purandhar Fort, Bhiva, (Cooke, 1). Distrib. China, Malay Islands.

Anatomical Notes.

Structure of the Leaf (Plate II, Fig. 3). Stomata are found on both sides of the leaf. They are surrounded by ordinary epidermal cells. The mesophyll is differentiated into palisade and spongy tissue. Epidermal cells are rather large.

Oxalate of lime is present in the form of large clustered crystals in the mesophyll, and in that of crystal-sand in the stem, as in *Pupalia lappacea* Moq. (Sabnis, 6). Mullan (5) has observed aggregate crystals and coarse granules in *Celosia argentea* L. The hairy covering (Plate II, Figs. 1-3) consists of ordinary clothing uniseriate trichomes both on the stem as well as on the leaves. Those on the stem are longer and in some cases provided with small protuberances in the upper portion. The hairs on the leaf form a fine tomentum. Capitate hairs with a unicellular or uniseriate stalk and unicellular spherical or ellipsoidal head, mentioned by Solereder (8) as having been observed by Nemnich in species of *Allmania* have not been seen.

Structure of the Stem. The herbaceous stem possesses stomata. They are not provided with any special subsidiary cells. No anomaly is found in the structure. The epidermis in the region of the ridges consists of small tabular cells with outer and inner walls slightly thickened and convexly arched outwards and inwards respectively. In the primary cortex chlorenchymatous cells occur with the collenchymatous groups at the angles. Stone-cells are found in the pericycle. There is an extensive pith composed of large thin-walled parenchymatous cells.

Conclusions.

The main anatomical characters revealed by the study of *Allmania nodiflora* R. Br. are: (1) stomata are surrounded by ordinary epidermal cells, and do not possess any special subsidiary cells; (2) oxalate of lime is present in the form of clustered crystals in the leaf, and in that of crystal-sand in the stem; (3) hairy covering consists of ordinary clothing uniseriate trichomes; (4) glandular hairs are absent.

Acknowledgments.

As before the photograph and the drawings were prepared by Mr. Sri Ramloo under my supervision, for which I am thankful to him. My thanks are also due to Mr. M. Moinuddin for the preparation of several slides.

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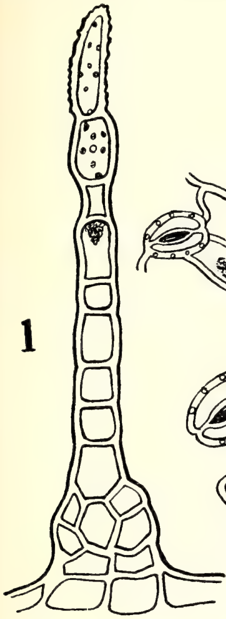

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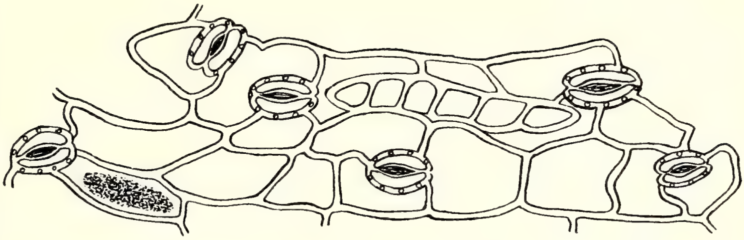

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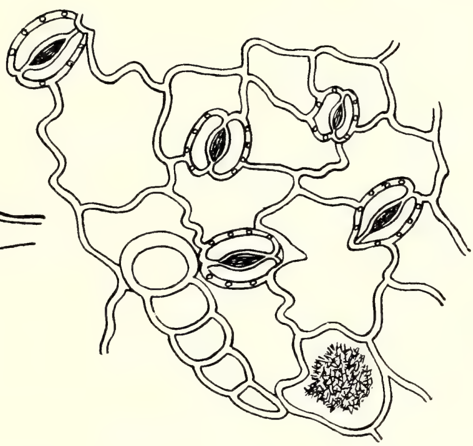

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For explanation see end of article.

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EXPLANATION OF PLATES I & II.

Allmania nodiflora R. Br.

PLATE I.

Fig. 1.—Black and white sketch of *Allmania nodiflora* R. Br. (Nat. size).
Fig. 2.—A dichasium, showing three flowers. (× 10).
Fig. 3.—A single flower with the calycine perianth opened out to show the parts (× 10).
Figs. 4 & 5.—Two views of the stamens, showing in (4) the lateral slits in the anthers for shedding of pollen. (× 10).
Fig. 6.—Pollen grain in dry condition. (× 10).
Fig. 7.—Pollen grain in moist condition. (x 10).
Fig. 8.—Pistil, showing the circumsciss dehiscence of the future fruit. (× 15).

PLATE II.

Fig. 1.—Uniseriate clothing hair on stem. (× 420).
Fig. 2.—Stem-epidermis, showing stomata, an ordinary trichome and crystal-sand. (× 420).
Fig. 3.—Leaf-epidermis, showing stomata, trichome and clustered crystals. (× 420).
Fig. 4.—Photograph of *Allmania nodiflora* R. Br.

(*To be continued*).

THE DEATH EXPEDITION OF *HIBISCUS* CATERPILLARS

(larvae of *Crocallis* sp.)

BY

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(*With a plate*).

The migratory instinct in lower animals often appears to be very peculiar and exceedingly interesting. The migration of the little rodent lemmings offers an excellent example. These little animals colonize a hill-side and multiply at an amazing rate, so much so, that when, owing to insufficiency of food supply, starvation becomes inevitable all the inmates of the colony, millions and millions strong, rush head-long from their dwelling place. Nothing can stop or divert this impetuous flow. Thousands and thousands of them die of starvation or of injuries, many more are devoured by predaceous birds or other enemies but still the stampede continues relentlessly until the sea is reached, where this instinct still impels them to press forward to some promised land which they never reach.

This instinct of the rodents of a breakneck migratory movement, heedless of the goal, is extraordinary indeed, but the instinct evinced by the larvae or caterpillars of the moth, *Crocallis* sp., which occupies a far more backward position in the process of biological evolution, in their reckless mode of migration is still more wonderful and thought provoking.

The moth, *Crocallis* sp., lays her eggs on the leaves of *Hibiscus Rosa-sinensis, Artabotrys odoratissima* and some other plants. The young larvae or caterpillars about 4 to 5 mm. in length, hatch out after ten or fifteen days and assemble under the surface of the leaves where they scrape off all the chlorophyll bodies leaving the thin films of cellulose. After a few days, growing larger, they devour the whole of the leaf and move over to a neighbouring one. Thus within a short period all the leaves of the plant are eaten up and the caterpillars begin to migrate to a new place for food and shelter.

Once early in May, I happened to notice such a migration of *Hibiscus* caterpillars (larvae of *Crocallis* sp.). I was standing near a cemented platform, built over a cemented floor at the corner of an extensive lawn, observing the leaf movements of a sensitive mimosa plant (*Mimosa pudica*), when at the far end of the floor a procession of greenish white caterpillars, numbering about sixteen individuals, crawled forward in single file over the lawn towards the platform. The order and regularity of their movement specially attracted my attention. The procession hurriedly approached

The Caterpillars are marching in a line towards the potted plant.

The Caterpillars are seen moving along the circular rim of the pot.

the raised platform, but finding its vertical wall too smooth to scale, changed its course towards the grassy lawn. Progressing a few feet onwards along the base of the platform, the caterpillars turned back towards the cemented floor. It was apparent from their movements that they had scented the leaves of the mimosa and were searching for a way to get at them. At last they descended to the cemented floor and now marched quickly towards the corner of the platform where the mimosa plant grew in its earthen pot. Closely following one another, the caterpillars went round the base of the platform and now, finding a suitably rough surface, climbed the vertical wall and made straight for the plant. On reaching it they dispersed and raising their heads began to smell about. After a short while they fell into line and climbed the pot, eager for their meal on the leaves of the plant. The file of caterpillars attaining the circular rim of the pot, now commenced—extraordinary to relate—what was going to be for them a continuous and interminable journey round and round the rim. The surface of the soil in the pot was somewhat below the rim necessitating a descent. While the close proximity of meal inspired them to brisker and brisker movement, the caterpillars did not take the one way which would have led them directly to the plant. They did not descend from the rim of the pot, blindly following the circular rim they were deceived into a vain and endless march.

The circumference of the rim proved too small for the whole length of the caterpillar chain. They had to squeeze themselves in for accommodation and every individual looked very much shorter in length than it did in the open space. Incessantly they marched round the rim of the pot throughout the day without a halt or rest, and their journey never came to an end.

Very carefully I removed the pot to my bedroom and watched the movement of the caterpillars every now and then during the night. As a rule, the larvae of moths refrain from eating after sunset and rest quietly until next morning, but these larvae marched through the night and carried on their unprofitable journey.[1] Through the next day, the march continued, but a slight slowing down was noticeable in the movement. On the third day, the weariness was more apparent. The inability of two or three individuals to keep pace with the others hampered the regular progress. At about 11 o'clock in the morning, one of the stragglers fell out of the line in a comatose state and expired after half an hour or so. Three hours later, another caterpillar dropped out and died. Now the death of the two individuals gave the others space to stretch out their bodies a little, so that no gap was to be seen in the file even in the absence of two members. The caterpillars were moving as usual head to tail, but their progress was very much slower than before. More deaths occurred on the fourth day, while the survivors seemed to be totally exhausted. They moved reluctantly and halted at intervals. On the afternoon of the fifth

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[1] Fabre described the processionary habits of tent caterpillars of the apple tree who kept following the line all day long but slept when night overtook them and resumed their journey with the morrow's sun.

day, some of the caterpillars dropped out of the regular line and took to crawling aimlessly over the pot but they never left it, for the smell of the green leaves was a constant and unconquerable source of attraction. So after a few hours of fruitless straying those which did not succumb came back to the rim of the pot and resumed the weary march. The length of the chain was now greatly reduced owing to the death of several individuals and a gap was formed between the head and tail of the moving chain.

On the morning of the sixth day most of the caterpillars were found lying dead on the platform or on the soil of the pot. The three that were still surviving and sticking to the rim were in a precarious condition and died soon after. Lured by the scent of food, and urged by the instinct to march relentlessly towards it, all of them ultimately embraced death but did not give up their pursuit for a moment.

Later it was observed that the leaves of *Hibiscus Rosa-sinensis* planted beyond the wide lawn were infested with the caterpillars of *Crocallis* sp. These caterpillars, voracious eaters as they are, had eaten up almost all the green leaves of those plants, and scarcity of food there had compelled them to migrate elsewhere for food and shelter. On several occasions after the incident noted above I was able to persuade different processions of these caterpillars to climb to the rims of circular vessels and in everyone of these experiments, the results were the same as in my first observation.

If during migration, water intercepts the path of their progress, the leading member by raising up its head looks around and, finding other means to avoid the obstacle changes its course, the rest of the party following in a regular line. When no alternative is available but to go through the water, they enter it, but reluctantly and as a last resort. As the film on the surface of water does not break under the weight of their bodies, the caterpillars float on it like bits of cork. Like a flock of sheep unhesitatingly following their leader, the caterpillars also follow the foremost member across the surface of water, some wriggling their bodies sideways try to proceed in a zig-zag manner. Unaccustomed to swimming, most of them by indiscriminate wriggling of bodies are led out of line. Those who are fortunate enough to cross the water assemble again in a line and resume their journey.

THE MEDICINAL AND POISONOUS FLAXWORTS OF INDIA.

BY

J. F. CAIUS, S.J., F.L.S.

The LINACEÆ are herbs, shrubs or trees, broadly distributed, especially in the northern hemisphere. They consist of 9 genera with 150 species.

The medicinal and poisonous Flaxworts of the world belong to 5 genera: HUGONIA (Tropics); IXONANTHES (tropical Asia); LINUM (temperate and subtropical regions, especially Mediterranean); REINDWARTIA (North India, China); ROUCHERIA (Guiana).

Ixonanthes cochinchinensis Pierre, which is used medicinally in Annam, is not found in India.

A. Petals contorted, fugacious. Perfect stamens as many as the petals. Herbs rarely shrubs
- I. Calyx glabrous or pubescent. Styles 5. Capsule 5-celled ... ... LINUM.
- II. Calyx glabrous. Styles 3-4. Capsule 3-4-celled ... REINWARDTIA.

B. Petals contorted, fugacious. Perfect stamens 2-3-times as many as the petals. Fruit a drupe. Usually scandent shrubs
- I. Sepals subacute, tomentose, ebracteolate ... HUGONIA.
- II. Sepals obtuse, bracteolate ... ... ROUCHERIA.

HUGONIA.

The genus consists of 11 species, inhabiting the Tropics of the Old World.

H. Planchoni Hook. f. is used medicinally in Liberia and Sierra Leone, *H. serrata* Lam. in La Reunion.

Hugonia Mystax Linn. is found in the Konkan and North Kanara of the Bombay Presidency, throughout the dry forests of the Madras Presidency, and in Ceylon.

The bruised roots are employed externally in reducing inflammatory swellings, and as an antidote to snake-bites. In the form of a powder, it is administered internally as an anthelmintic and febrifuge. The bark of the root is also employed as an antidote to poisons.

Mhaskar and Caius have shown experimentally that the root is not an antidote to snake venom.

Canarese : Modirakkanni— ; *English* : Climbing Flax— ; *Malayalam* : Moderakkanni, Motirakkanni— ; *Sinhalese* : Bugatteya, Mahagetiya— ; *Tamil* : Agori, Kodivirai, Modirakkanni— ; *Telugu* : Gatrinta, Kakibira, Penkebedali, Pisangi, Renangi, Tivvaputiki, Ungaralapidemu, Vendapa— ; *Tulu* : Mullankola— ; *Uriya* : Chulijinka—.

LINUM.

The genus numbers 90 species, inhabiting the temperate and subtropical regions of the world, but especially Mediterranean.

The seeds are oleaginous, emollient, and sometimes purgative. *Glucosides*—linamarin, phaseolunatin—are among the products isolated. *Linin*, a peculiar drastic principle has been obtained from *L. catharticum* Linn.

The following are used medicinally in Europe—*L. alpinum* Linn., *L. angustifolium* Huds., *L. austriacum* Linn., *L. catharticum* Linn., *L. gallicum* Linn., *L. flavum* Linn., *L. hirsutum* Linn., *L. maritimum* Linn., *L. narbonense* Linn., *L. nodiflorum* Linn., *L. perenne* Linn., *L. strictum* Linn., *L. suffruticosum* Linn., *L. tenuifolium* Linn., *L. usitatissimum* Linn., *L. viscosum* Linn.—; in China—*L. perenne* Linn.—; in North America— *L. catharticum* Linn., *L. usitatissimum* Linn.—; in Brazil—*L. usitatissimum* Linn.— in Uruguay—*L. selaginoides* Lam.—; in Chili—*L. Chamissonis* Schiede, *L. Macraei* Benth., *L. selaginoides* Lam.—; in South Africa— *L. Thunbergii* Eckl. and Zeyh.—; in Mauritius— *L. usitatissimum* Linn.—.

A. Petals blue
- I. Capsule scarcely exceeding the narrowly white-margined sepals ... ... *L. usitatissimum.*
- II. Capsule much longer than the white-margined sepals ... ... *L. perenne.*

B. Petals yellow ... ... *L. strictum.*

1. **Linum perenne** Linn. is found in the North-Western Himalaya, extending westwards to the Canaries.

In Europe and in China the seeds are used as an emollient.

Country people, in England, boil the fresh herb and take it for rheumatic pains, colds, cough and dropsy.

Chinese: Ya Ma—; *English*: Perennial Flax—; *French*: Lin de Sibérie—.

2. **Linum strictum** Linn. occurs in the Punjab and the North-Western Himalaya, from Soongaria to the Mediterranean.

The seeds are used as an emollient in Spain.

Arabic: Farq, Kittan, Zir—; *Punjab*: Bab-basant, Basant—.

3. **Linum usitatissimum** Linn. is cultivated throughout India up to 6,000 feet.

The bark and the leaves are useful in gonorrhoea.

The bark when burnt and applied to wounds stops the bleeding and promotes the healing process.

The flowers are considered a nervine and cardiac tonic.

The roasted seeds are said to be astringent. Fumigation with the smoke is recommended for colds in the head and hysteria, and the tinder is used to staunch haemorrhages.

Linseed poultice is recommended for gouty and rheumatic swellings; as an emollient, the mucilage is dropped into the eye; with honey it is prescribed in coughs and colds.

The seeds are used internally for gonorrhoea and irritation of the genito-urinary system. The decoction is used extensively. Occasionally the seeds are powdered and taken with sugar.

In Iraq local druggists recommend linseed poultice for chest troubles.

An infusion of the seeds has long been given in Europe for soothing a sore chest or throat in severe catarrh or pulmonary complaints. As a domestic remedy for colds, coughs, and irritation of the urinary organs, linseed tea is most valuable. A little honey and lemon juice makes it very agreeable and more efficacious. It is taken in wineglassful doses, which may be repeated *ad libitum*.

The crushed seeds, or linseed meal, make a very useful poultice, either alone or with mustard. In ulceration and superficial or deep-seated inflammation a linseed poultice allays irritation and pain and promotes suppuration. It is commonly used for boils, abscesses and other local affections.

Tumours of a simple nature, and sprains, may be usefully rubbed with linseed oil. The oil forms, when mixed with lime water or with spirit of turpentine, a capital external application to recent burns or scalds.

Internally, the oil is sometimes given as a laxative; in cases of gravel and stone it is excellent, and has been administered in pleurisy with great success. It may also be used as an injection in constipation. Mixed with honey, linseed oil has been used as a cosmetic for removing spots from the face.

The oil enters into veterinary pharmacy as a purgative for sheep and horses, and a jelly formed by boiling the seeds is often given to calves.

Linseed has occasionally been employed as human food; but it affords little actual nourishment and is apparently unwholesome, being difficult of digestion and provoking flatulence. It has been mixed with corn for making bread, but it proved indigestible and hurtful to the stomach, and even was responsible for the death of many.

There is in England an Act of Parliament still in force which forbids the steeping of flax in rivers, or any waters which cattle are accustomed to drink, as it is found to communicate a poison destructive to cattle, and to the fish inhabiting such waters.

Cattle poisoning by linseed flowers is fairly common in Bengal and Bihar. The linseed flowers and the immature seeds contain the maximum amount of a cyanogenetic glucoside producing as much as 0.69 per cent of free hydrocyanic acid. About half a pound of flowers is sufficient to kill a bullock.

The seeds of *L. usitatissimum* Linn. and the oil from them are officinal in all pharmacopoeias, except that of Mexico.

Amam: Ho ma—; *Arabic*: Bazar-ul-katan, Bazr-ut-kattan, Kattan—; *Behar*: Chikna, Tisi—; *Bengal*: Masina, Mosina, Musni, Tisi—; *Bombay*: Alasi, Javas, Javasa—; *Brazil*: Linho—; *Bundelkhand*: Bijri—; *Canarese*: Agashi, Alashi, Alsi—; *Catalan*: Lli—; *Celtic*: Lin—; *Chinese*: Hou Ma—; *Danish*: Hoer—; *Deccan*: Alshi, Javas—; *Dutch*: Vlas—; *Egypt*: Kittan—; *English*: Common Flax, Flax, Linseed, Lint, Lyne—; *Finland*: Lin, Pellavan—; *Formosa*: Hu-ma—; *French*: Lin, Lin chaud, Lin commun, Lin cultivé—;

German : Flachs, Haarlinsen, Lein, Saatlein— ; *Greek* : Linon— ; *Gujerat* : Alshi, Alsi— ; *Hamadan* : Basarak— ; *Hebrew* : Bad— ; *Hindi* : Alsi, Tisi— ; *Hungarian* : Len— ; *Iraq* : Kittan— ; *Italian* : Lino— ; *Kashghar* : Zighir— ; *Kashmir* : Alish, Keun— ; *Kolami* : Unshi— ; *Konkani* : Sonnbium— ; *Kumaon* : Alsi, Tisi— ; *Kurdish* : Gosh— ; *Loralai* : Alsi— ; *Madagascar* : Rongonimbazaha — ; *Malayalam* : Cheruchanavittintevilta— ; *Marathi* : Alashi, Javas, Javasa— ; *North-Western Provinces* : Bijri— ; *Norwegian* : Lin— ; *Persian* : Basarak katun, Bazarug, Bazr-ul-katan, Tukhm-e-katan, Zaghir, Zaghu— ; *Polish* : Len— ; *Porebunder* : Alasi, Javas— ; *Portuguese* : Linhaca, Linho— ; *Punjab* : Alish, Alsi, Tisi— ; *Roumanian* : In— ; *Russian* : Len, Lyon— ; *Sanskrit* : Atasi, Auma, Chanaka, Devi, Haimwati, Kshauma, Kshaumi, Kshuma, Madagandha, Madotkata, Malina, Masina, Masrina, Masruna, Masuna, Matasi, Nilapushpi, Nilpushpika, Parvathi, Pichhila, Rudrapatni, San, Sunila, Suvarchala, Tailottama, Uma— ; *Spanish* : Lino— ; *Swedish* : Lin— ; *Tamil* : Alshi— ; *Telugu* : Atasi, Madanginjalu, Ullusulu— ; *Turki* : Ziggar— ; *Turkish* : Keten— ; *Urdu* : Alasi— ; *Uriya* : Pesu— ; *Yugoslavia* : Lan—.

REINWARDTIA.

The genus consists of only 2 species, one Indian and the other Chinese.

Reinwardtia trigyna Planch. is found along the Himalaya from the Indus eastwards, the Salt Range, Simla, Kumaon to Sikkim up to 6,000 feet, Assam, Chittagong, Bihar, Mount Abu, Bombay Konkan and Ghats, the Western Ghats, the forests of South Kanara and Mysore. It is distributed to Siam, Tongking and China.

It is used as a medicine for 'founder' in cattle.

Deccan : Abai— ; *Dehra Dun* : Basant— ; *Jaunsar* : Pengun— ; *Kumaon* : Piuli, Piunli— ; *Matheran* : Abai— ; *Punjab* : Balbasant, Basant, Gudbatal, Gulashruf, Karkun, Kaur— ; *Saora* : Labodatar—.

ROUCHERIA.

The genus consists of 4 species, natives of Guiana.

Roucheria Griffithiana Planch. is found in Malaya; common in low country, Singapore, Malacca to Perak and Penang. It is distributed to Sumatra and Borneo.

The plant is used in the preparation of the dart-poison of the Sakais.

Malay : Akar biji, Akar kait putih, Akar musiang, Garam-garam, Ipoh akar putih— ; *Sakai* : Bhoi—.

A STUDY OF THE COURTING HABITS OF *MYRMARACHNE PLATALEOIDES* (CAMBR.)— A SPIDER MIMIC OF THE INDIAN RED-ANT *OECOPHYLLA SMARAGDINA*.

BY

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The familiar red ant is mimicked by a few insects and spiders. Two spider mimics are fairly common and well known to naturalists in this country—the attid mimic, *Myrmarachne plataleoides* and the thomisid mimic *Amyciaea forticeps.* The habits of these spiders were studied by me, and in the course of my studies I made interesting observations on their mating habits. Comparison of these mating habits with the ordinary behaviour of these spiders in the field under different conditions, was found to be instructive. In this article the mating habits of *M.plataleoides* as observed in the field and in artificial cages, are described.

This spider moves about on plants infested by the red ants amongst which it would easily be overlooked. Though when it moves about ordinarily it is truly *Oecophylla*—like, while distrubed it betrays its arachnid and attid characters and to one who would patiently observe, the distinction becomes fairly easy.

One evening while out searching for these spiders during the Christmas holidays 1928, at Mavalikara, Central Travancore, I came across a nest outside which there was a full-grown male. It was observed for nearly half an hour: but I could not understand what it was about. Except for an occasional show of restlessness it remained patiently and calmly outside the nest. Evidently something inside was engaging its attention. As I did not want to wait longer, I thought of securing the specimen. Getting closer I was just attempting to drive it into an open tube, when, to my surprise, a female ran out of the nest and began 'staring' at me. Quite probably they were courting. Both the specimens were soon secured in tubes.

At home the specimens were placed in a large glass cage and watched closely. They wandered about the cage erratically for some time during which they met each other a number of times. At first they were too frightened to take notice of each other but later on there were signs of 'recognition'. They would pause and look at each other for a while, the male showing some signs of excitement. As the male however approached the female, the latter would run away. But after a little while they stopped and faced each other. The male raised its body on its legs and inclined the

falces downwards giving the body an arched form. In this attitude it approached the female in a series of short sudden jerks. As it drew nearer, the excitement increased and its movements became more jerky, turning now to the right and then to the left. Thus it 'displayed' itself before the female with bowed falces arched and uplifted body and with the first pair of legs lifted up; moving in sharp sudden jerks sideways and forwards. All the while the female was closely watching the 'antics' of the male, often turning in such a way as to keep it in full view. Both were in a state of great excitement. The male advanced slowly towards the female in this queer jerky manner till their front legs just touched. A few rapid mutual strokes by the palpi followed and with this the short 'dance' ceased. The arched body of the male resumed its normal position and all excitement seemed ended. The female remained quiet, slightly raising the abdomen and twisting it slightly to one side. The male moved forwards, got astride the female on one side, and felt with its palpus for the epigynum. The palpus on that side nearest to the female's abdomen was applied to the epigynum and for about five minutes they remained in this position. The male then moved backwards and then again moving forwards got astride the female on the other side and the other palpus was applied to the epigynum. The copulation over, the male moved away, while the female remained quiet for a little time.

Similar modes of courtship and pairing have been observed a number of times in my cages where mature males and females were kept together. But a few other observations which I have made on these spiders and their allies in the field have convinced me that this is not the normal way in which pairing takes place under natural conditions but that this occurs only under artificial conditions.

On several occasions I have taken males and females from the same nests and their behaviour and the readiness with which they paired when put together make one feel certain that they must have been pairing or preparing for pairing within the nests.

On one occasion I observed a male and a female of this spider moving about on the same leaf. As it was very inconvenient to watch them there I secured them and placed them in a cage. They ran about for sometime and eventually faced each other. The male soon began to pay attention to the female. It approached the latter in the usual jerky excited manner turning to one side and then to the other in regular alternation; but the female would turn round and run away. The male however persisted in paying his attentions and at last the female stopped, turned round, and faced the male. They touched each other by their forelegs and then the female stroked the falces of the male by her palpi. Some mutual recognition must have passed between them! For, this time, unlike the previous instances, no attempt was made at immediate pairing but after an 'agreement' as it were, the female hurried off to a corner of the cage and began busily to make a nest. The male showed no anxiety to pursue her. It watched the female closely, and leisurely moved towards her. When he neared, the female left off her work, came out and stroked the male with her palpi for a second and immediately hastened away to her work. The male

quietly continued waiting outside. The female worked very fast and soon got a nest ready. The next day the male was found to get in and pair.

Similar observations I have made in a mimic of the small red ant *Solenopsis* and also in certain dark mimics.

During the summer of 1930 and again in 1931 I had further opportunities to observe the courting habits of these spiders at Parur in North Travancore. While these observations generally confirmed the view given above that pairing takes place within the nest, certain other interesting details were noted.

On the 4th June 1930 I came across a nest in which were a male and a female. Closer scrutiny showed that they were not in the same chamber but were in two separate compartments of the same nest. There was a well-built nest in which the female was. This nest was completely covered over by a larger silken dome, rather sparsely woven, and within this was the male. From this chamber he had free access to the female's compartment. They remained each in its respective compartment quietly for four days. On the morning of the 8th I was surprised to note that the female had moulted and that its cast off skin was lying on a side in the nest. It was very surprising for it meant that the spider was, till then, only in the penultimate stage and was not a mature female. After some time the male who appeared to have been watching all these events showed restlessness, got out of its retreat and began to wander about the leaf for some time. Then it returned to the female's nest, was admitted into it, the female meeting it at the entrance and showing the usual expressions of excitement and then they paired inside the nest.

On the 8th June 1930 two of these spiders, a male and a female were seen on the underside of a plantain leaf. The female was very busy weaving a nest while the male was quietly observing from the outside, occasionally fastening a few strands overhead making the outer nest. In a short time the nest was completed and the female took her position in the inner and well constructed nest. The male waited outside for a long time. Then it was noticed to wander away returning in about an hour. It waited outside and made no attempt to get into the female's nest. Till the 12th June I observed them in the same position. On the 12th morning the female had moulted; the male was still waiting outside. These were not further observed but there is no doubt that soon the male must have got into the female's nest and paired.

Again at Parur, on the 8th May 1931, a female was observed in the hollow of a leaf within a nest of closely woven silk. Outside this and enclosing it, was a larger nest which was not however so carefully constructed as the inner one but consisted merely of a large number of silk strands. In this outer enclosure, was a male. They remained quietly till the 10th when the female was found moulted. The male came out of the retreat, moved about the leaf for a while and then returning to the female's nest entered the nest and paired.

On the 17th December 1931 I again observed a female in a fully formed nest with a male watching outside. The next morning

the female had moulted and by noon they were observed to pair inside the nest.

A few double nest of the same pattern as described above were observed at Mavalikara, Central Travancore, on the 16th September 1932. One of these was kept under observation. On the 19th night the female moulted and on the 20th I noticed them pairing within the nest.

Since making these observations, I have, almost every time I was out in the field searching for these spiders, come across one or more of these double nests or mating nests each having a female in the penultimate stage in the inner chamber and an adult male in the larger outer chamber. A number of times I have taken these females to examine if they are in the penultimate stage. On a few occasions they were found to be adults; but in all these cases the moulted skin lying inside the nest bore unmistakable testimony to the fact that its moulting to the adult was quite recent and took place only after she retreated into the mating nest. In the few previous instances of pairing which I observed and have recorded above, it is likely that the cast off skins in the nests were overlooked since such a phenomenon was not suspected at all.

In August 1933 I made very similar observations on the courting habits of two black mimics—*M. manducator* and another species not yet identified—from Cape Comorin and Vattakottai near the Cape. A number of mating nests with the females in the penultimate stage guarded by adult males were seen. Similar mating nests were also observed at Courtallam beyond the Ghauts, in August 1934.

In January 1932 the following observation was made. A male in the course of his wanderings came across a female still within its nest. This female was in the final stage. The male approached the nest with some jerks but without the details of courting which were observed when it took place in the open, and introduced both its first pair of legs into the female's nest. She was agitated, showed a few jerky movements and embraced the front legs a number of times. The male withdrew for a moment and then immediately returning, thrust the front legs as before into the nest. The female stroked the front legs with her palpi and front legs. This was repeated two or three times and then the male entered the nest and paired with the female.

In July 1934 the following experiments were made on *M. plataleoides* in cages. On the 14th of July I secured a mature male and also a female in the penultimate stage: these were put in separate cages for a day. At night they made their usual silken chambers and retreated into them.

The next morning I introduced into the cage in which the mature male was, a female in the penultimate stage. The female wandered about the cage and came across the male in his retreat. She moved towards the entrance of this retreat and introduced her forelegs and anterior region of her body into it. The male met her and a few rapid jerky strokes of the palpi and contacts of front legs followed. The male then hurriedly got out of the nest

and the female directly got into it. She immediately began to make the walls of the nest thicker. The male waited outside for a few minutes and then wandered away for a while. However, it soon returned and took up its position outside the retreat and spun a few silken strands over his body and enclosing the female in her retreat. The next morning the female had moulted and a little later I saw the male getting into the nest and pairing. As he got into the nest the female met him at the entrance and the usual strokes of the palpi took place.

In the other cage where a female in the penultimate stage was kept and which had made a retreat of its own, I introduced a mature male. He wandered about the cage a little and then came across the nest of the female. Without any delay he thrust the first pair of legs and his elongated chelicerae into it. The female who was resting within with the head turned in the opposite direction, immediately turned towards the male and they felt each other by their front legs and palpi. This was accompanied by a few jerky movements of the body. The male then retreated from the nest and waited outside while the female remained quietly within the nest. The next morning she had moulted and a little later the male got in and they paired within the nest.

Again, I kept a mature female in a cage. She made a retreat and rested within. The next day while the female was still in her retreat, I introduced a mature male into the cage. He wandered inside the cage a little and then came across the female's retreat. As in the previous experiment, here also the male directly introduced himself into the nest, his forelegs and falces thrust out in front. The apparently 'surprised' female felt the intruder with her palpi and front legs which immediately enabled them to recognise each other. After a little more of touches of legs and palpi, the male got into the nest and they paired inside the nest.

These observations show that the male in the course of his wanderings, *if he comes across a female which is only in its penultimate stage and is in her moulting chamber, takes charge of her and waits outside her nest patiently for her final moult to take place: that he, while thus waiting outside makes a large and loosely-woven nest outside the female's chamber and enclosing it. In this outer nest he remains. When the female has moulted and thus attained 'maturity' he gets into the inner nest without any special courtship and they pair within the nest. If however, he comes across a mature female within her nest, he directly introduces himself into the nest and pairs with her inside the nest.*

Several spiders are known to pair within 'pairing nests'[1] But the antlike spiders of the family Attidae are supposed to pair outside any nests.[2] My observations of several species of *Myrmarachne* however convince me that in this genus at any rate pairing does not take place in the open but only inside nests though in

[1] T. H. Montgomery, 1910. *The American Naturalist,* vol. xliv.

[2] G. W. and E. C. Peckhams, 1889. Occ. Pap. of the *Nat. Hist. Soc. of Wisconsin* 2.

a state of confinement they may be noted to pair in the open. *The necessity for retreating under the shelter of the silken canopy for pairing will be obvious when we remember that they live in the company of the ferocious red ants and that if pairing takes place in the open they run the risk of being surprised by the forager ants from the ant colony.*

The observation that the males take charge of young females in the penultimate stage and wait till the latter moult, is not, however, without parallel though, as far as I could ascertain, no such observation has been recorded of any Indian spiders or, of any ant-mimicking spiders. However, one can be sure that if only the habits of spiders are sufficiently observed, many such instances would be forthcoming from the abundant spider-fauna of this land.

A number of American Attidae have been observed where the male seizes an immature female and lives with her in mating nests till she moults and becomes mature.[1] Peckham has shown such a behaviour in *Philaeus militaris*.[2] McCook has given certain additional instances[3] and Montgomery has described similar habits in *Phidippus purpuratus*.[1] They have also described members of other families such as Drassidae, Therididae and Lycosidae behaving in a similar manner. The commonly observed instances of the males of many orb-weaving spiders waiting near the webs of immature females must also be parallel phenomena to these. In a British clubionid, *Clubiona trivialis* the male is known to construct a nest near the nest of the female and tap upon the partition between them sometimes for days together.

Mating seems to be promiscuous; a male in the course of its wanderings may come across a female in the penultimate stage, in which case he waits outside for her to moult and then pairs with her. Or, if he comes across a mature female in her nest he gets in and pairs with her. The male may mate with a number of females successively and in the same way a female, after being impregnated by a male, may receive other males into her nest and pair with them successively.

From the above-recorded observations we may draw the following conclusions:—

1. When a mature male and a mature female are placed together in a cage the male 'courts' the female with characteristic jerky movements, uplifted front legs and bent abdomen and finally pairs with her in the open.

2. Under natural conditions however, such cases of courtship have not been observed. On the other hand males have been many times observed to come across females in their nests. The male without any formality introduces himself into the nest at the entrance of which the female meets him and there follows a few

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[1] T. H. Montgomery, 1910. *The American Naturalist*, vol. xliv.

[2] G. W. and E. G. Peckhams, 1889. Occ. Pap. of the *Nat. Hist. Soc. of Wisconsin* 1.

[3] McCook, 1890. American spiders and their spinning work, vol. ii.

'passes' of the front legs and palpi during which they appear to 'recognise' each other. If the female is an adult he gets in forthwith and mates with her. If she is only in her penultimate stage, he withdraws from the nest, and remains outside making a larger nest enclosing the female's nest and waits within it till she moults. After this event he gets in and pairs with her. If the female spider is not yet in the penultimate stage, she hastens away and escapes from the nest on feeling a male pushing himself into her nest.

3. The male is able to distinguish between a mature female and a female in the penultimate stage whom he had come into contact with and adapt his behaviour accordingly. At the same time the immature female—it is only natural that the mature females should recognise the male—which is only in its penultimate stage appears to have already attained to the 'adolescent instinct' which enables her to recognise and prepares her to receive the male.

'The Dance'.

The movements made by the male during courtship in the open, which, had not the later observations been made, would, certainly have been designated the 'courtship dance' deserves a little closer study. I have studied the behaviour of these spiders when they come across a stranger or a rival—the spider stops suddenly, looks closely at the stranger, the body is raised high on the legs, the falces are sloped downwards, and the first pair of legs are lifted upwards. A short pause in this attitude, and then he slowly approaches the other in short jerky movements or cautious measured steps. On approaching he seems to get clearer impressions about the other, for, his behaviour is modified according to it. If it is a large and formidable enemy it has faced, it suddenly darts back and escapes. If it is a rival male they both take up a fighting attitude. If it is a female he continues his jerky approach till their forelegs touch each other which appears to convey to each other the information they want. Quite possibly then, these *'courtship movements'* and their behaviour when they come across any stranger are more or less similar in their earlier phases—only later as the movements proceed and the spiders get more definite impressions of the objects engaging their attention, they take different aspects.

Some insight into this phenomenon can be got by an investigation of what are called Abnormal courtship dances of several male spiders.

Peckham has recorded a male *Phidippus mccookii* 'court' a female *P. clarus* while Locket saw a male *Tarentula barbipes* 'performing' in front of a male *Trochosa ruricola*. Berland noticed a male *Saitis barbipes* 'courting' in the absence of a female! Thus there are several recorded instances of male spiders beginning their 'courtship actions' before other males, mature or immature, of

their own species or even of another species.[1] My own observations on *Myrmarachne plataleoides* have shown that the preliminary parts of the 'courtship movements' *were exhibited by the male in the presence of other males or other spiders even if separated from it by glass partitions.* Nay, they have even on a few occasions been noticed *to begin these movements before their own images in a mirror!*

On one occasion when I casually turned towards one of my glass cages in which a mature male was kept, I saw him suddenly turn to a side and begin his 'courtship' movements. Of course, he did not continue it far but it was interesting that similar movements to 'courtship' were noted when apparently there was none nearby to cause any excitement. Probably Berland's observation of male jumping spiders courting 'nothing' is closely similar to this. He attributes this to Physiological excitement. It may be so; but while investigating this a simpler explanation that occurred to me is that the spider was not really courting 'nothing' as at first it appeared to be; but my movements in front of the glass cage either directly or by reflections on the sides of the cage gave the spider an idea of some stranger moving close by. It immediately put on its attitude of scrutiny and caution.

These 'abnormal courting phenomena' tell us that—

1. The male may *begin* the 'courtship movement' before other males, other spiders or even their own images.

2. The male does not need to 'recognise' the female by sight or by smell before he begins 'courting'. In fact the stimulus that initiates the movements of the male appears to be only something vague rather than anything definite.

3. When under these conditions 'courtship' has begun it does not however proceed to its culmination. As the male gradually approaches the object of his attentions he must certainly be getting some more definite impressions about the latter. If it is a male of another species its behaviour would be quite different; they may quietly resume their ways or the stronger would chase away the other. If it is an individual in a separate glass cage that has engaged the spider's attentions, it would soon find it physically impossible to get closer and failing to get the proper stimuli he would stop his attentions. On the other hand if it is a female whose presence has initiated these movements, as they approach they get more definite impressions of each other either by sight or smell and this would stimulate them further till their front legs touch each other. This is the climax of their effort to recognise each other; the cautious, 'on guard' attitude is given up and they prepare to pair.

Conclusion.

Our study of the courting habits of *M. plataleoides* has shown—

1. That 'courtship antics' *do not take place usually in the natural*

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[1] T. H. Savory, 1928. The Biology of spiders.

state where the male merely gets into the nest occupied by the female and pairs with her within the nest.

2. When a certain form of 'courtship' appears to take place under certain conditions, *the spiders do not seem to recognise each other fully—there being only a general impression of a stranger at first.*

3. The earlier phases of those movements which constitute this 'courtship' *are similar to those made by the male when he comes across any stranger.* In the open under confinement, these movements proceed and if the object engaging his attentions chances to be a female of the same species, the necessary impressions are sooner or later received which stimulate the sex instinct in both and they approach one another and prepare to pair.

These would partly appear to support the views of Professor Montgomery[1] in his interpretation of the courtship phenomena among spiders. He remarks that the adult male is excited by sexual desire and at the same time by fear during courtship and that the movements of the male at this time 'are for the most part *exaggerations of ordinary motions of fear and timidity'.*

Here the male, however is bigger and he need not fear his mate in any way: yet his movements are suggestive of extreme caution. When however he comes across a female in her nest—as happens under natural conditions—he does not wait for any of his 'display' but merely gets into the nest through one of its opening. At the opening of the nest they meet and 'recognise' each other. *The cautious movements which are exhibited when they meet outside any nest are to be looked upon as the spider's peculiar way of 'on guard' approach towards a stranger for the purpose of 'finding out' its real nature, his eyes at a distance having given him only a vague impression.* When a male and a female confined in a cage have once met they thereafter meet and embrace a number of times without any repetition of the special movements.

Against this view it has been pointed out that the courtship antics are not exactly the ordinary movements of excitement, self-defence and caution. It may be so in many spiders but in *M. plataleoides* which has been the subject of this study there is practically very little difference. Montgomery, however, analysing the instincts at work in the male and the female during courtship believes that the male recognises the female and is excited by sexual instinct; at the same time he is afraid of her and hence his attitude of self-defence. The latest theory of Bristowe and Lockett[2] which is only a modification of Montgomery's views is stated thus—[3]'Since the male spider runs the risk of being killed and eaten by the female the first use of his courtship antics is to enable her to recognise him as a male and not to regard him as something to be eaten. When he has begun his courtship the male spider is practically safe but it takes a varying amount of continued

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[1] T. H. Montgomery, 1910. *The American Naturalist,* vol. xliv.
[2] W. S. Bristowe and G. H. Locket, *P.Z.S.* XXII, 2.
[3] T. H. Savory, 1928. The Biology of spiders.

solicitations to stimulate the female so effectively that she submits herself to him. Recognition and stimulation are therefore both necessary before mating can take place.'

As Savory remarks[1] this later theory appears to be needlessly complex, attributing mental powers to the spider which it probably does not possess. Both the above-mentioned interpretations assume that the male is much better able to recognise the female than she is to recognise him.

The above study of 'courtship' in *M. plataleoides* shows that here at any rate a simpler interpretation is possible. *When 'courtship' begins the spiders do not appear to fully recognise each other but behave as if they are confronted by any stranger, 'recognition' taking place only as these movements have proceeded considerably, the finale of this attempt at recognition being reached when their forelegs have actually come into contact.*

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[1] T. H. Savory, 1928. The Biology of spiders.

REVIEWS

I.—A FACSIMILE OF R. H. BEDDOME'S ARTICLES ON INDIAN REPTILES 1862-1870. By Malcolm Smith. *Journ. Soc. Bibl. Nat. Hist.*; vol. I, part 10, pp. 273-334—15th May 1940. Price 15*s*.

Consisting of seven articles contributed by R. H. Beddome to *The Madras Quarterly Journal of Medical Science* and its short-lived successor, *The Madras Monthly Journal of Medical Science,* with illustrations and marginal notes, this slim brochure gives the specialist the sort of first-hand information which is usually out of his reach. It is recommended to every serious student of herpetology, and to all who are interested in the bibliography of natural history.[1]

J. F. C.

II.—THE TETRAPOD REPTILES OF CEYLON. *Volume I*: *Testudinates and Crocodilians.* By P. E. P. Deraniyagala. Pp. xxxii+412. *Ceylon*: Colombo Museum; *London*: Dulau & Co.; 1939. Price: Rs. 10 or sh. 15.

A warm welcome will be given to this book, the work of an author well qualified to deal with the reptiles of Ceylon in their many different aspects. Mr. Deraniyagala has done his task exceedingly well, and his book is a model of what such things ought to be: clear and exact statement, selected and arranged so as to give the most ready assistance.

Although the author gives much that is already known about the testudinates and crocodilians of Ceylon, his work is obviously not a thing of scissors and paste and second hand information, for the amount of new material incorporated by far outweighs the rest. For instance, the sections on the Leathery Turtle and the Estuarine Crocodile mark a great achievement in that they present so much which is entirely new.

The book contains 24 plates, 137 text-figures, 62 tables, a systematic index, a glossary of technical terms, a bibliography, and indexes of names: English, Sinhalese, Tamil, Scientific, authors. It is essentially a work of reference, and it is difficult to write about it; its thoroughness can only be tested by use.

J. F. C.

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[1] Published by 'The Society for the Bibliography of Natural History', 41, Queen's Gate, London, S.W. 7.

WANTED INFORMATION ABOUT MAHSEER.

Members who are anglers in India will be reading with much interest the series now being published in the *Journal* on 'The Game Fishes of India'.

Dr. Sunder Lal Hora discusses on pages 279 to 282 of Volume xli the why and wherefore of the hypertrophied lips of certain mahseer in certain rivers; and asks that 'To elucidate this problem it is highly desirable that anglers may kindly note the condition of the lips of the mahseer caught by them and also make a detailed note of the length,' etc., etc.

It is hoped that anglers will kindly do what they can to assist Dr. Hora in the manner suggested.

EDITORS.

MISCELLANEOUS NOTES

I.—HOW THE MONGOOSE COUNTERACTS SNAKE BITE.

With reference to my letter of the 27th of March regarding the habits of my crab-eating mongoose (*Herpestes urva*) I was told the other day by a Burman that these animals have a patch on the tongue which contains medicine to counteract a bite from a poisonous snake. I examined carefully the tongue of my mongoose and found it to be of normal red colour except for a small patch in the middle about the size of an elongated 3 penny bit. This patch is dark grey in colour and covered with fine spines of what appears to be hair. I do not know if this is recorded in the smaller species of red snake-catching mongoose. It is not altogether unlikely that this rough patch on the tongue could serve for the purpose of cleansing a wound inflicted by a poisonous snake. I would be very grateful if you would let me know if you have ever heard of this theory before and whether the small species of red mongoose has a similar rough hairy patch on the tongue.

AMHERST DISTRICT, MOULMEIN.

A. L'E. BROWNLOW, *District Superintendent of Police.*

[The idea that mongooses are immune to the bite of the cobra and resort to the eating of various roots and herbs to counteract the effect of the poison is very prevalent. But the story about the patch on the mongoose's tongue, containing medicine to cure snake-bite is a new one. The central patch on the tongue of the mongoose is composed of numerous papillae. These horny papillae are to be seen on the tongues of many carnivorous animals. They are encased in horny pointed sheaths. Their function is purely mechanical. The numerous rigid points give the tongue the action of a rasp designed to remove remnants of flesh adhering to bones, etc. These conical papillae tend to form spiny patches on the fore part of the tongue and the patch referred to has probably the function which we have indicated.

While the blood of the mongoose, like the blood of cats, has a certain resistance to snake venom, a mongoose, once injected with a fully lethal dose, will not survive. EDS.]

II.—A LARGE PANTHER.

(*A correction*).

I find that in your issue of the Society's Magazine, vol. xli, p. 656, you have been kind enough to publish an account of the World Record Panther shot by me.

I find however that owing to some oversight in my Office the name of wrong Taxidermist has been entered. The skin was

cured by Messrs. Theobald Brothers, Mysore, and not by Van Ingen & Van Ingen, Mysore.

Enclosed herewith a true copy of the Taxidermist's Certificate which I possess.

PALACE, YASHODHAR SINGH.
KHILCHIPUR,
CENTRAL INDIA.
May 22, 1940.

[In Rowland Wards Records of Big Game there is a record of a panther measuring 8′ 6″ before skinning (9′ 3″ dressed). It was shot at Banipur Kashmir by Col. A. G. Arbuthnot. EDS.]

III.—THE SHORT-NOSED FRUIT-BAT (*CYNOPTERUS SPHINX*) AS AN AGENT OF SEED DISPERSAL IN THE WILD DATE (*PHOENIX SYLVESTRIS* L.).

Standing in my garden at dusk on the 8th August (1940), I noticed a constant stream of bats flying in and out of the crown of a date palm (*Phoenix sylvestris*). The palm was laden with ripening fruit. At first I took the bats to be the Fulvous Fruit-Bat (*Rousettus leschenaulti* Desm.), but the flight did not seem to be that of *Rousettus*. Being interested, I got my torch and net and took my stand under the tree. In the fading light the crown of the palm was silhouetted against the sky and the bats could be clearly seen coming in, ferreting among the dates and then flying off. In the beam from the torch the colour of the animals soon betrayed their identity, they were the short-nosed Fruit-Bat (*Cynopterus sphinx*). Though dazzled, the bat did not seem to mind the light much. It made alighting difficult and in most cases the bats flew off again, but when the light was turned on once they had settled, they did not worry about it much. They would hurriedly select the ripest dates and fly off with one in the mouth. At no time did any of them finish its meal on the spot. I soon caught some on the return flight to the tree. An examination of the mouth revealed pieces of the scanty pulp of this date, adhering to the teeth. The stomachs contained much liquid and just traces of well-masticated pulp. From this it seems that this bat, like the Flying-Fox and *Rousettus*, relies mainly on juice and not on pulp.

By carrying off the fruit to be eaten elsewhere and there dropping the seeds when done with, the bats unconsciously become agents of seed dispersal. Bats are not unknown as agents of seed dispersal; and [1]Ridley in his book quotes several instances, though

[1] *The Dispersal of Plants throughout the world*, p. 349.

he does not specifically mention *Cynopterus* as an agent of the date palm (*P. sylvestris*). However, he states that in Africa, where the genus *Cynopterus* is absent, *Rousettus* is known to feed on dates and disperse the seeds. While feeding the bats made no noises.

A point worth noting is that the genitals were in non-breeding condition at this season. The testes were invisible externally indicating that they 'atrophy' after breeding just as in *Rousettus*. Among the adults were a number of young adults which did not appear to exhibit the characteristic ferruginous tints of their elders. This seems to show that this bat, like *Rousettus*, breeds earlier in the year, perhaps about the same time as the latter species.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
August 10, 1940.

IV.—JUNGLE AND HOUSE CROWS AS DESTROYERS OF GAME.

This year, in the beginning of April, I noticed house crows arriving in the town of Bhavanagar in increasing numbers. Trees in which ten and twenty crows used to roost, now held at least a hundred if not more. The numbers in which they arrived was striking, reminding one of travelling parties of pilgrims. This preponderance of crows was also noticed in several large villages in the State. The increase may have been due to the famine prevailing in parts of Kathiawar, and to the scarcity of water in those districts. Here we have been fortunate this year in having good rains, but the crows have left no peace for breeding partridges and other birds.

The Jungle Crow, especially, has been a great menace to partridges, destroying their chicks. During this summer, I saw not less than half a dozen partridges robbed of their young. April and May seem to be the breeding season of the Jungle Crow here, and hence during this period the parent birds become fearless, attacking young birds, squirrels, and any living thing which they can tackle. It was a pathetic sight to see a pair of jungle crows destroying tiny partridge chicks despite the parents' vain attempts to protect them. Other small birds fared as badly. The Jungle Crow levies a heavy annual toll on young partridges. I am sure most nesting birds shudder at the call of the crow, which is a prolonged *qwauu qwauu*, generally emitted with outspread wings. Interpreted it must mean a general invitation to the robber band 'Food is here come and help yourselves'.

The House Crow does useful work as a scavenger. I have constantly observed parties of crows leave in the early mornings to visit villages ten or twelve miles away, specially to feed on dead cattle. They return to their roosts late in the evenings with full crops; but as avid destroyers of young birds and their eggs they are great criminals. And their depredations were particularly

bad on account of their abundance. House crows frequently combine in their marauding.

This hot weather, when making notes on the habits of the Common River Tern, a very interesting bird to study during the nesting season, I noticed one of these marauding parties of crows harassing a small colony, which had selected an island on our lake for their nesting. Morning and evening troops of crows would fly around the island, they were attacked immediately and vigorously by the terns, which succeeded in driving them away from time to time. The terns had the advantage of speed, and did not permit the crows to settle on their islands, nevertheless the raiders did not abandon their purpose. Reinforcements arrived, more and more crows came, and by sheer numbers, the raiders were eventually successful in stealing two eggs from the twenty-seven that were on the island. The raids continued day by day, the eggs were reduced until there were none, and the terns were compelled to evacuate their breeding grounds.

K. S. DHARMAKUMARSINHJI.

BHAVANAGAR,
April 15, 1940.

V.—NOTES ON THE NESTING OF LEGGE'S FLOWER-PECKER (*ACMONORHYNCHUS VINCENS* [SCLATER]).

(*With a plate*).

As there are no records of the nesting of this species, a description of the nest I found last February, may be of interest.

It was built about 75 feet from the ground in one of the lower branches of a *Dipterocarpus zeylanicus* which stands in a strip of jungle on this estate.

These trees are tall and straight, the trunk being bare of branches for 60 feet or more, and then breaking out into a fairly large head. The leaves are stiff, and from 5 to 8 inches long.

The nest was suspended from a leafy twig, being well protected from above by the foliage. It was larger than most Flower-peckers' nests, measuring about 4½ inches in length, and as will be seen from the photograph, had a pronounced hood over the somewhat large entrance.

It was rather fragile, being made of reddish vegetable down and cobwebs. The small furry seed cases of some plant were also incorporated, and were of the same reddish brown colour. The outside of the nest was decorated with dried leaf bracts or stipules, of varying size, two or three long ones being attached to the bottom of the nest.

Unfortunately I waited too long, and missed getting the eggs. The hen incubated for such brief periods, that I was under the impression that she was still building. It was only when I saw both cock and hen going regularly to the nest, that I realised my mistake.

There were two young. Only the hen built the nest and brooded the eggs. All observations had to be done with field glasses, and

Nest of Legge's Flowerpecker (*Acmonorhynchus vincens*).

the nest was so well screened by leaves, that it was very difficult to get a good view of it.

The trials of getting it down were much enhanced by the large red ants which swarmed among the leaves,—and at times all over the Sinhalese climber. They give a very painful bite.

I have seen fledgelings of this Flowerpecker in August, so it is probably double-brooded.

I am much indebted to W. W. A. Phillips, Esq., for the excellent photographs of the nest, which he has kindly allowed me to use to illustrate these notes.

I found another nest of this species in June. The young were just leaving it. It was built in the same species of tree, but in a very large specimen.

It was well within the crown, and about half way up it, built in a topmost spray of an erect branchlet about 3 feet high, growing from the main portion of a large limb.

The height from the ground was estimated at 125 feet. The tree was rather isolated and in an exposed position, standing on the edge of the jungle where it adjoined tea.

This tree was about fifty yards from the tree where the first nest was found, and I have every reason to believe it was built by the same pair.

CICELY LUSHINGTON.

HOUPE,
KAHAWATTA,
CEYLON.
April 10, 1940.

VI.—THE OCCURRENCE OF THE YELLOW-BELLIED FLOWERPECKER (*PACHYGLOSSA MELANOXANTHA* HODGS.) AT ALMORA, U.P.

Among the small collection of birds made at Almora by Mr. W. A. Hewitt, is a specimen of the Yellow-bellied Flowerpecker (*Pachyglossa melanoxantha*) ♀. This specimen was obtained at Almora Kumaon District—altitude 6,800—in August 1940. The range of this species, according to New *Fauna*, is given as 'Sikkim and Nepal to Eastern Assam and the higher hill ranges south of the Brahmaputra'.

S. H. PRATER.

BOMBAY NATURAL HISTORY SOCIETY,
August 27, 1940.

VII.—THE OCCURRENCE OF THE DRONGO CUCKOO (*SURNICULUS LUGUBRIS* HORSF.) IN THE PUNJAB.

I thought it might interest you to know that I am almost certain I have seen a pair of *Surniculus lugubris* here.

The bird answers the description of the Drongo Cuckoo given in the *Fauna of British India*, vol. iii, p. 223. I should say

the birds are young though, as I did not handle them, I did not see any white feathers. I first noticed them sitting on the telegraph wire beside the golf club house, and at first glance thought they were the King Crow until I noticed the tail, which had the outer feathers considerably shorter than the rest and slightly protruding.

According to the distribution of this bird given in F.B.I. it is rare in the Indian Peninsula and this part of India is not given as a likely locality. The paragraph finishes up by saying that it is probably more widely distributed, but owing to its great resemblance to the King Crow it is apt to be overlooked. This encourages me to believe that it may be the bird, and I would be very grateful if you would tell me whether you think this is possible or not.

The King Crow itself is not a common bird here in Jullundur except in the breeding season. I only saw *Surniculus* (?) a week ago; and on four consecutive days they have been in the same place, and I venture to think they have only just arrived or I would have seen them before as I spend a great deal of time watching birds.

7, Napier Road, MRS. A. B. M. WAY.
Jullundur,
Punjab.
September 5, 1940.

[The Indian Drongo Cuckoo *S. l. dicruroides* is described as being found in Upper India and Assam, extending into Northern Burma. It is obviously a rare visitor to the Punjab. Col. Rattray in a paper on the Birds of the Murree Hills, (vol. xvi, 661) describes it as a very rare species, which was shot in the Murree Hills at 5,000 ft. in 1899. Then A. J. Currie, in a note on the Cuckoos of the Punjab (vol. xxiv, p. 549), states that he heard the notes of this bird in a garden in Lahore, and identifies the call unmistakably as belonging to this species. Eds.]

VIII.—A NOTE ON THE ALPINE SWIFT (*MICROPUS MELBA BAKERI* HARTERT).

In a letter to me, Mr. Humayun Abdulali has pointed out that the resident race of *M. melba* is *bakeri* Hartert, and not *M. m. melba*, a point we overlooked in the joint paper by Mr. A. R. Hughes and myself, *On the road to Gersoppa and back* (*Journ. B.N.H.S.* vol. xli, p. 446).

With regard to the breeding of this bird, we were merely quoting from the *Fauna* [F.B.I. (Birds) 2nd Ed. vol. iv, p. 325]. If the birds breed 'during June and perhaps the last week of May,' then it was quite reasonable to expect the swifts there in numbers, but this was not the case at the time of our visit in June 1938. Mr. Ali's record in the *Journal* (vol. xxxviii, p. 830), 'The male,

with fairly large salivary glands had testes measuring 18×8 mm. The female with a shelled egg in the oviduct, had the salivary glands very much more enlarged.' seems to definitely establish that this swift breeds in December at the Gersoppa Falls, and not in June as mentioned in the *Fauna*.

Commenting further on my observations Mr. Ali writes,

'But your note raises an interesting question. Where do the birds go during the rains? You found them absent in June, and I did not see them either, when I was down at Gersoppa on the 3rd August, last year (1939). A friend of mine however, was there on the 7th September and almost certainly saw the swifts. As a matter of fact, he dropped his camera lens over the ledge on the British side, he saw 'many small birds flying about in the mist'.

The birds appear to leave the falls from June to August, or, as you must have heard from the Chowkidar at the Dak Bungalow, the pigeons and swifts store large reserves of food in the crevices and thus hibernate through the monsoon'!!

As already stated in the joint article Mr. Hughes and I saw no birds in June (1938), but I have seen them in thousands in October (1919). I also stated that I shot this bird in the Pulnai Hills during June and July (1921). At that time they were about those hills in fair numbers. My observations, and Mr. Ali's subsequent visit in August, seem to suggest that there is a definite migration to other parts during the full force of the monsoon, but where the thousands of birds go to is yet to be discovered.

C. McCANN.

Bombay Natural History Society,
Bombay.
July 31, 1940.

IX.—VULTURES 'FEEDING' AT NIGHT.

Mr. Livesey's interesting experience with vultures feeding on a carcase at night—on page 55 of your *Journal* (vol. xl—No. 4—May 1939)—has prompted me to quote the following entry from my 'shikar diary' in respect of very similar proceedings witnessed by me when shooting in the Nepal Tarai and the Maharani of Khairigarh's jungles early this month with the Maharaj Kumar of Vizianagram.

'On 6-4-40 the Maharaj Kumar and I sat up for tiger in the Nepal jungles. This was in dense tree and grass jungle where it joined the *narkul* and *ratwa* grass jungles. A pair of tigers had overnight killed one of our large-size buffalo *paddas* at cross-paths some 50 yards into the tree jungle. At the crossing was a clearance some 30 x 40 yards with a few big trees and right round was dense tree and cane jungle. The kill had been dragged towards clumps of cane. We decided to sit up and so the kill was dragged back into the clearing at about 4-30 p.m. Half an

hour later we took our seats in a comfortable machan and had hopes of the tigers, which were certainly present earlier in the evening, turning up. But alas! all our hopes were blasted by vultures who must have been particularly famished! When we arrived, several of the high trees round about were full of these birds waiting patiently. Up to the time we got into the machan our men were about, but they left when we were comfortably settled in, two of them remaining hidden about 100 yards away for some time in case anything was required. The sun was high, and from 5-30 p.m. to 8-0 p.m. the men did nothing but charge the vultures, who every 10 minutes or so fell on the kill. After 8-0 p.m. no further attempt was made to get rid of them and, when we got down from the machan half an hour later, some 20/30 of them were still feeding. We flashed our torches on them and, after craning their necks at us, they continued their repast as if nothing had happened. Several of them, which had fed to repletion, were sitting about at the edge of the tree jungle and, owing to the darkness, could not fly to safety. Some of them tried to do so, missed their mark, and fell to the ground. Those on the ground were not molested by any animal and were none the worse for being on the ground on a dark night.

This episode was astonishing to me for I was always under the impression that after sun-down vultures never alighted at kills, especially in jungle where they could easily be ambushed.

On returning to camp I consulted the two head shikaris, one a local man and the other of Mirzapur, who said that nothing unusual had happened. According to them vultures, which have had even a partial feed, will not come down after sunset, but, if they have been kept off, as was the case here, they are very bold and throw discretion to the wind. They may have a shrewd knowledge of the presence of the killer, but when hungry very frequently take their chance. One of the shikaris told me that he was once watching a kill from a tree. At about 6 p.m. a few vultures, from among many that were sitting round, ventured to alight and peck at the kill. This brought the tigress out and she chased some birds for 20/30 yards. While she did this other birds, which had meantime alighted, tackled the kill. These proceedings were repeated a dozen times till the tigress left in disgust and the birds had their feed. No vulture was killed though 3/4 had been hurt by blows aimed at them by the tigress. This incident took place in Khairigarh jungles bordering on the Nepal Tarai.'

I can offer no comment beyond that I was truly surprised at the conduct of the vultures who seemed to suffer from a type of fatalism. We had had several other kills where such behaviour was not resorted to.

It would be interesting to learn of the experiences of others.

E. S. LEWIS.

10, RAJPORE ROAD,
DELHI,
April 28, 1940.

[In volume xxxviii, p. 190 Mr. R. C. Morris published a note on 'Vultures feeding at night'. The birds descended from neighbouring trees at about 8 p.m. and by 11 p.m. they had completely demolished the carcase. It was a moon-light night.

On p. 624 of the same volume, Mr. W. Gough records an identical incident when sitting up for tiger near Neemuch. Eds.]

X.—INJURIES TO THE FEET OF A MALLARD.

Last February I shot a Mallard, the feet of which appeared to have suffered a loss of portions of the web and 'toes', the latter being in certain cases, mere stumps, and having the appearance of the ravages of 'Frost Bite', or amputation as might occur from a jaw-trap. The injuries were of no recent date, as there were no raw or open scars, and the bird—a drake—was in capital condition, being one of the heaviest of the species I've shot—well over $3\frac{1}{2}$ lbs.

W. P. KEELAN.

Arcadia T. E.,
Dehra Dun, U.P.
July 19, 1940.

XI.—ADDITIONAL NOTES ON THE BIRDS OF BOMBAY AND SALSETTE.

Since the publication of the final part of our paper on 'The Birds of Bombay and Salsette' we have obtained several fresh records, and our attention has been drawn to overlooked data. This is an attempt to bring the paper into line with the information available today, and we hope to be able to bring out these supplementary reports from time to time.

Several of the records merely duplicate previous observations, and are entered for completeness. We are also including a number of nesting records from the adjacent country, since almost no information is available from our area, and these might facilitate further work.

We would like to place on record our appreciation of the considerable amount of data obtained by Br. Navarro at Khandāla, and we hope to be able to publish a more complete list of the mass of interesting details that he has procured in that locality.

1.—Birds new to the Bombay-Salsette list.

The Indian Pied Myna: *Sturnopastor contra contra* (Linn.).

At Dharāvi, near Sion Station, a pair of these mynas was noted several times in a localised area and one was seen singing lustily in a Bombax (April 1940). H.A. also saw another pair near Kūrla during the monsoon last year, but these records may refer to 'escapes' since this is a common cage bird.

The Pigmy Wood-pecker: *Dryobates hardwickii hardwickii* (Jerdon).

A solitary bird was observed on a *Bombax* in open deciduous forest near Borivli on 31-12-39, and a pair on the Wada Road some 20 miles North of Bhiwandi, on 27-6-37. There is also a specimen obtained by Fr. Palacios at Mūrūd, Janjira, during August, 1937. These records show that the bird is sparsely distributed throughout our area.

The European Roller: *Coracias garrula semenowi* Loudon & Tschusi.

Further to the Khandāla records mentioned in *J.B.N.H.S.* xl, p. 168, a specimen was obtained in Bombay City during December, 1938.

The Blue-winged Paroquet: *Psittacula columboides* (Vigors).

This bird was twice seen on a hillside in heavy forest at Tungar Hill near Bassein on 2-4-34. Brother Navarro has records of c/3 on 4-2-40, and c/3 on 15-4-40, both from Khandāla.

The Jungle Nightjar: *Caprimulgus indicus indicus* Latham.

A specimen obtained at Chembur on Trombay Island was sent in to St. Xavier's College during December, 1939. This species may be a rare resident in our area, as it was noted common at Kardi (near Ātgāon) on the Nāsik Road.

It is also common at Khandāla, where Navarro has taken 3 clutches of 2 eggs each during May, 1937. He records that in each clutch one egg was distinctly larger than the other.

Franklin's Nightjar: *Caprimulgus monticolus monticolus* Franklin.

A specimen was obtained by D. A. Barretto at Kūrla on 10-1-40. The characteristic *sweesh* call of this bird is too distinctive to be overlooked, and this individual may have been a straggler.

The Brown Hawk Owl: *Ninox scutulata lugubris* (Tickell).

A male, with dormant testes was shot at Bandra on 13-1-40, by Mr. Knox. The specimen, which is now in the St. Xavier's College Collection, was examined by Sálim Ali who places it with *lugubris*. The colour is intermediate between *lugubris* and *hirsuta*, while the head is darker than *lugubris*. The wing measures as 213 mm.

The Indian River Tern: *Sterna aurantia* Gray.

This tern was noted as common on flooded mud flats at Bassein on 17-9-39. There is a specimen in the St. Xavier's College Collection obtained at Trombay.

The Large Crested Tern: *Thalasseus bergii* ssp.

One was noted going over the ternlet colony at Utan Washi on 28-5-37. Considering that a sub-species of this bird is common further south and breeds on the Vingūrla Rocks, it is likely that stray birds do occasionally turn up round Bombay. It is of course essentially a bird of the sea.

The Large Indian Cormorant: *Phalacrocorax carbo* [*sinensis* (Shaw & Nodder)].

Several were seen at Tānsa Lake on 18 April 1940. The white about the head and on the thighs is unmistakable. The bird is also appreciably larger than the other cormorants and much stockier than the Darter.

The White Ibis: *Threskiornis melanocephalus melanocephalus* (Latham.).

In the St. Xavier's College Collection there is a specimen shot by Fr. Palacios in Rewdanda Creek on 8-11-33. This Ibis is also common in the Deccan, and a large flock was seen at Lake Beale on 22-10-39.

The Glossy Ibis: *Plegadis falcinellus falcinellus* (Linn.).

A bird was shot by Fr. Palacios of St. Xavier's College, in Rewdanda Creek on 8-11-33. A pair was observed by H. A. in salt pans at Bassein on 17-9-39. This species is common at Nasik and in the Deccan generally.

The Reunion Petrel: *Petrodroma aterrima.*

On 15-6-40, a specimen was sent in alive to St. Xavier's College. After some speculation regarding its identity, and in the absence of any material for comparison, it was forwarded to the Colombo Museum, and has been named as this species by Mr. G. M. Henry of that place. This bird is new to the Indian area; its distribution is given as 'Western Indian Ocean near Mascarenhas Island, and breeds at Reunion Island' (These islands are off Madagascar). The specimen was obtained by fisher-folk near Colaba Lighthouse, and considering that *Puffinus persicus* has also been procured in the same area this year, it appears that petrels may be commoner about our coast than existing records indicate, and further collaboration with fishermen might produce interesting information.

2.—Additional notes relating to Birds already mentioned in our original paper.

The Southern Grey Tit: *Parus major mahrattarum* Hartert.

Several were noted on 13-2-38, some 20 miles north of Bhiwandi, along the Wada Road. Navarro took an egg at Lonavla.

The Common Babbler: *Argya caudata caudata* (Dumont).

Navarro has a record of three fresh eggs taken in a bush in an orchard at Bandra on 2-3-40.

The Deccan Scimitar Babbler: *Pomatorhinus horsfieldi* Sykes.

On 9-11-39, Navarro took c/3 fresh and c/3 half-incubated at Khandāla.

The White-throated Babbler: *Dumetia hyperthra albogularis* (Blyth).

We took c/4 at Khandāla on 3-9-39.

The Bombay Quaker Babbler: *Alcippe poioicephala brucei* Hume.

Navarro obtained c/3 at Khandāla on 10-11-39.

Jerdon's Chloropsis: *Chloropsis jerdoni* (Blyth).

Navarro has two records of nests with 2 eggs obtained at Khandāla on 13-6-40.

The Indian Stone-Chat: *Saxicola torquata indica.* (*Blyth*).

Birds were seen on bushes bordering snipe country near Kihim on 19-10-32.

The Indian Shama: *Kittacincla malabarica malabarica* (Scopoli).

Navarro has taken 2 clutches of 4 eggs each at Khandāla on 15-4-38 and 27-5-38.

The White-throated Ground Thrush: *Geokichla citrina cyanotus* (Jardine & Selby).

Records appear to indicate that this bird is a monsoon visitor to Salsette, and further notes would be of interest.

The Blue Rock Thrush: *Monticola solitaria pandoo* (Sykes).

The first and last records of this bird are on 2-10-33 and 18-4-35.

The Paradise Flycatcher: *Tchitrea paradisi* [*paradisi* (L)].

The last record from Salsette is on 3-5-34, but Navarro has obtained eggs (c/2) at Khandāla on 17-3-40. The sub-species requires confirmation.

The Pale Brown Shrike: *Lanius isabellinus* Hempr. & Ehrenb.

The appearance of this species in our parts in the cold weather of 1939-40 *may* have some connection with the failure of the monsoon in its usual winter quarters further north and west. A male was shot on the mud-flats near Rewas in Dharamtar Creek on 3-12-39, and another was obtained at Ghoti, Nasik Dist. on 1-1-40. It was then noted as common. Another was seen in 'katchar-patti', Trombay Island, on 26-1-40.

The Black-headed Cuckoo-Shrike: *Lalage sykesi.* Strickland.

Navarro obtained a c/3 at Khandāla on 27-5-39.

The Bronzed Drongo: *Chaptia aenea malayensis.* Blyth.

A pair was observed in deciduous forest at Borivli on 31-12-39, where they were occasionally hawking very close to the ground; another example on 7-4-40, a few miles from Thana. It may be a winter visitor.

The Racket-tailed Drongo: *Dissemurus paradiseus malabaricus* (Latham).

A c/1 was observed along the Tulsi Flume on 18-6-39. On 7th April, 1940, the forest north of the Dahisar stream was rapidly cut down, and several Racket-tailed Drongos were seen in deforested country which can now be termed scrub, with a few stunted clumps of bamboo. Will the birds migrate to heavier forest or acclimatize themselves to scrub?

Franklin's Wren-Warbler: *Franklinia gracilis gracilis* (Franklin).

A bird was building at Vihar Lake on 3-7-38.

The Black-headed Oriole: *Oriolus xanthornus maderaspatanus* (Franklin).

Another nest with c/3 was obtained at Powāi Lake on 5-7-36, and young out of nest were also observed.

The Rosy Pastor of Rose-coloured Starling: *Pastor roseus* (Linn.).

Birds were seen at Bhyandar as early as 20th Aug. 39. This *might* be due to the drought in the North.

The Grey-headed Myna: *Sturnia malabarica malabarica* (Gmelin).

Navarro obtained a c/1 at Khandāla on 18-6-39, and this is the nearest breeding record available. In Salsette it appears to be commonest during the monsoon and cold winter.

Blyth's Myna: *Sturnia malabarica blythii* (Jerdon).

On 9-9-39, a party of four or five was observed at Trombay Island.

The Jungle Myna: *Æthiopsar fuscus mahrattensis* (Sykes).

A pair was observed at Powai on 20-4-40. By June quite a colony appear to have settled down among the palms now standing on marshy land exposed by the drainage of the lake. One pair was noted building in a hole in a headless brab. Common Mynas are also present, but these appear to keep to drier land.

The Indian Red Munia: *Amandava amandava* (Linn).

A small party, all in female plumage, was observed at Vihār on 2-2-34.

The Black-headed Bunting: *Emberiza melanocephala* Scopoli.

A small flock was observed between Mumbra and Panvel on 18-3-39. It was common near Ghoti, Nāsik Dist. on 1-1-40.

The Crag Martin: *Riparia rupestris* (Scop).

These birds were observed at Khandāla on 30-11-39. They were noted as common near Lake Beale on 1-1-40, as well as at Niphad on 17-3-40.

The Dusky Crag Martin: *Riparia concolor* (Sykes).

On 2-7-38, a pair was observed nesting over a door-way at Worli, Bombay City. Another pair was building at Kampoli—Bhor Ghat on 1-3-39. On 3-9-39, the latter nest site had been shifted by about 10′ and the birds were still building. Water was apparently seeping up to the old nest, and the material for the new nest was obtained from the old one.

We have no breeding records in the City, except during the monsoon. The nests found during March-April, are situated near springs in the Ghāts. The availability of water may therefore constitute a factor governing single or double broods.

The Indian Wire-tailed Swallow: *Hirundo smithii filifera* (Stephens).

On 28-7-40, birds were seen visiting a nest under a culvert at Bhiwandi, Thāna Dist.

The Indian White Wagtail: *Motacilla alba dukhunensis* Sykes.

It may be interesting to note that the same roosts are used year after year on migration. Does this indicate memory among birds?

The Small Indian Skylark: *Alauda gulgula gulgula* Franklin.

A c/3 was found at Colaba Reclamation on 7-9-38, while a c/2 was picked up at Godhbunder in snipe country on 8-10-39.

Tickell's Flowerpecker: *Dicaeum erythrorhynchos erythrorhynchos* (Latham).

The breeding season appears to be more prolonged than indicated by us previously, as a nest with 2 chicks was obtained at Bhiwandi, on 26-8-38.

The Southern Yellow-fronted Pied Woodpecker: *Dryobates mahrattensis mahrattensis* (Latham).

This bird was seen busy at flowers (nectar?) of *Sterculia colorata* at Kaneri, Borivli, on 19-4-35.

The Rufous Woodpecker: *Micropternus brachyurus jerdonii* (Malherbe).

On 25-6-39, Navarro obtained a c/2 from a nest alive with ants at Khandāla. A pair at work demolishing a 'live' *Crematogaster* nest interrupted work to remove the unwelcome ants off their persons. The alarm note is a quick low '*qu-uk*'. The rectrices do not appear to be as stiff as those in other woodpeckers and this may be correlated with their un-woodpeckerlike habit of perching across a branch.

The Malabar Heart-spotted Woodpecker: *Hemicircus canente cordatus* Jerdon.

On 21-5-39, a pair were seen suspiciously near a hole in dry branch along Wada Road near Sūriāmal, and another pair was observed elsewhere. We have two further sight records from Salsette: 31-3-36 and 31-12-39. The call is harsh and jerky rather like an Iynx's.

The Indian Cuckoo: *Cuculus micropterus micropterus* Gould.

This bird appears more common than indicated before, at least during the monsoon. The call is difficult to discriminate from that of the Scimitar Babbler, except that it always comes from the tops of trees, and there is occasionally an extra syllable. A male was shot on 28-7-40, at Tānsa River north of Bhiwandi.

The Common Crow-Pheasant or Coucal: *Centropus sinensis parroti* Stres.

A bird was observed carrying grass blades at Trombay, on 9-9-39. Navarro has obtained young at Khandāla on 23-5-38.

The Large Alexandrine Paroquet: *Psittacula eupatria* ssp.

A pair was shot at Bandra on 20-8-32. The specimens are in the St. Xavier's College Collection.

The Loriquet: *Coryllis vernalis* ssp.

These birds were noted as common in small parties, about 8 miles north of Bhiwandi along Wada Road, on 28-7-40.

The Indian Three-toed Kingfisher: *Ceyx erithaca erithaca* (Linn.).

A c/1 was obtained from a hole in cutting in wooded hill-side, on road-side at Powāi on 5-7-36. A newly hatched chick with 2 eggs was found in a nest in a similar situation at Suriamal during the rains in the same year.

The Indian Black Eagle: *Ictinaëtus malayensis perniger* Hodgs.

On 12-11-39, Navarro located a bird building at the top of a tall tree down in the valley at Khandāla, but it had apparently deserted the nest at a later visit.

We have several sight records of this bird in Salsette and the neighbouring area. It appears too distinctive to be confused with any other species.

A specimen was shot at Virār, a little north of Salsette on 14 Jan. 1940. (*J.B.N.H.S.* xli, 899).

The Black-winged Kite: *Elanus coeruleus vociferus* (Lath.).

A specimen was obtained in Tūlsi-Vihar area on 25-2-40. Its stomach contained a *Mabuya carinata* lizard.

The Pied Harrier: *Circus melanoleucus* (Forst.).

A specimen was shot in early November, and another observed at Panvēl, on 25-2-34.

The Indian Emerald Dove: *Chalcophaps indica indica* (Linn.).

A loud cooing, reminiscent of a large wood-pigeon, often heard in Salsette, has been traced to this bird. On 21-3-40, Navarro took a c/2 at Khandāla.

The Indian Rufous Turtle-Dove: *Streptopelia orientalis meena* (Sykes).

Several were seen at Godhbunder on 23-3-38.

The Jungle Bush Quail: *Perdicula asiatica asiatica* (Lath.).

A bird with young was seen at Powāi in March 1939. On 17th September 1939, a female with soft egg in ovary was shot in paddy stubble at Tūngar, near Bassein.

The Southern Painted Partridge: *Francolinus pictus* (Jard. and Selby).

A male shot calling off a tree near Bhiwandi on 17-9-39, had enlarged testes and was obviously breeding. The breeding of most of our game birds does not appear to coincide with the statutory close season.

The Ruddy Crake: *Amaurornis fuscus fuscus* (Linn.).

Specimen No. 266 noted in *J.B.N.H.S.* xl. 629 should be dated 21-6-36 and not November.

The Coot: *Fulica atra* Linn.

A bird was seen at Bhyandar as early as 29th Aug. 1939. On 3-9-39 there were quite a few birds on Panvel Tank. In the St. Xavier's College Collection there is a single egg labelled 'Bombay, 1910.'

The Demoiselle Crane: *Anthropoides virgo* (Linn.).

This is, of course, a common visitor to the Deccan during the cold weather.

The Indian Stone Plover: *Burhinus oedicnemus* ssp.

One was seen at Andhēri in a deserted garden on 4-2-40.

The Large Indian Pratincole or Swallow-Plover: *Glareola maldivarum maldivarum* (Forster).

On 1-9-39, a solitary bird was shot on the road at Bhyander. It appeared to be a tired straggler.

The Little Tern or Ternlet: *Sterna albifrons albifrons* Vroeg.

The colony at Utan Washi was visited again on 4-6-39, and numerous nests observed. The parents were noted wetting the eggs by dipping themselves in sea-water every few minutes. This is described in *J.B.N.H.S.* xli, p. 433.

Jerdon's Little Ringed Plover: *Charadrius dubius jerdoni* (Legge).

Navarro has had two birds taken off clutches both of 3 eggs on 24th May at Khandāla, identified as *jerdoni*.

The Eastern Curlew: *Numenius arquata lineatus* Cuvier.

Snails, mudfish and fiddler crabs appear to form a fair proportion of the food of these birds.

The Whimbrel: *Numenius phaeopus phaeopus* (Linn.).

This bird is a prominent passage migrant in Salsette. Stomach examined, contained remains of snails and crabs.

The Ruff and Reeve: *Philomachus pugnax* (Linn.).

On 29-8-39 one was shot out of a flock of 25 in a slushy maidan covered with short grass at Bhyandar.

The Curlew-Stint or Pigmy Sandpiper: *Erolia testacea* (Pallas).

This was common at Nala Sopara on tidal mud-flats on 17-9-39.

The Wood Snipe: *Capella nemoricola* (Hodgs).

One shot at Ambarnath in Jan. 1940 has been recorded in the *Journal* vol. xli, p. 665.

The Persian Shearwater: *Puffinus persicus* Hume.

A female was brought in alive by fishermen to St. Xavier's College from Colaba Light-house on 3-7-40. Legs and feet pinkish white: outer part of tarsus and outer toes including web black. Iris brown; bill brown. Wings 221 mm. cul. 31 mm. tar. 36 mm. tail 80 mm.

The Indian Spoonbill: *Platalea leucorodia major* (Temm. & Schlegel).

We have several sight records from the surrounding area, and it appears to be well known to most local shikaris as 'paat'. At Lake Beale near Ghoti it was very common on 1-1-40.

The Open-billed Stork: *Anastomus oscitans* (Bodd).

On 4-2-40 a solitary bird was seen at north end of Vihār Lake.

The Yellow Bittern: *Ixobrychus sinensis sinensis* (Gmelin).

Specimen No. 268 obtained at Powāi and recorded in *J.B.N.H.S.* xli, p. 648 should be dated 21-6-36, and not November.

The Flamingo: *Phoenicopterus ruber antiquorum* Temm.

A flock of eight was noted at Bhyandar on 20-8-39. One with downy head was shot out of a party of three at Dharamtar Creek on 12-11-39. This was a drought year in Cutch and Gujerat.

The Spot-bill or Grey Duck: *Anas poecilorhyncha poecilorhyncha* Forster.

On 7-4-40 a pair was observed at Powāi, where shooting is now prohibited. When settled the spots on the beak are distinct, while in flight the red legs are prominent. This bird breeds in Niphad, Nāsik Dist.

The Garganey or Blue-winged Teal: *Querquedula querquedula* (Linn.).

Several were shot at Bassein on 17-9-39. A small party including a male in full plumage was observed at Powāi on 7-4-40.

The White-eyed Pochard: *Nyroca rufa* Linn.

This was observed with the party of Garganeys at Powāi on 7-4-40.

The Tufted Pochard: *Nyroca fuligula fuligula* (Linn).

Mr. McCann reports seeing a party on Tūlsi Lake on 3-2-40.

BOMBAY,
September 24, 1940.

HUMAYUN ABDULALI,
SÁLIM ALI.

XII.—SOME BIRDS OF LOWER BURMA.

I record below the names of five birds that I have shot during this month in Insein and Tharrawaddy districts, which were apparently not found by Mr. Standford.

Criniger phaeocephalus (Grey Headed Bulbul). One of a pair found in dense evergreen forest in the foothills of the Pegu Yomas between Taikgyi and Gyobyu.

Hemipus picatus (Sykes Pied Shrike). A male found in deciduous forest near Taikgyi.

Aethopyga cara (Tenasserim Yellow-backed Sunbird). A male found in very dense evergreen forest near Taikgyi.

Arachnothera longirostra (Little Spider Hunter). A female found in deciduous forest near Taikgyi.

Chrysophlegma flavinucha (Goulds Yellow-naped Woodpecker). Fairly common in the teak forest foothills of the Pegu Yomas near Nyaungbinzin.

Yesterday I saw a large flock of pure white ibis flying over lake Hlawga. I think these birds must have been *Tantalus leucocephalus* (The Pelican Ibis) which Oates stated were abundant in the Plains of Pegu in his day, though Mr. Standford only records having come across *Threskiornis melanocephalus*, the white Ibis, during his 3 years.

RANGOON,
May 28, 1940.

J. A. M. SYMNS.

XIII.—SOME BIRDS OF THE OILFIELDS, BURMA.

I give below the names of three birds found by me in the vicinity of Yenangyaung, Magwe District, that do not appear in Mr. MacDonald's list of birds from the Mingyan District.

Tephrodornis gularis pelvica (Nepaul Wood Shrike). One specimen shot in the open scrub country in July 10 miles outside the Oilfields was identified by Mr. Garthwaite of Maymyo as being of this species.

Picus mahrattensis (Yellow-fronted Pied Woodpecker). By far the most common woodpecker of the scrub country round Yenangyaung.

Chaliophaps indica (Bronze-winged Dove). Seen on two occasions in the thicker wooded parts of the Pin Chaung when out Jungle Fowl shooting.

RANGOON,
May 28, 1940.

J. A. M. SYMNS.

XIV.—BIRDS EATING BUTTERFLIES.

I have been up in Nepal (Katmandu) for the last month and while there an incident occurred which might be worth recording in the *Journal of the Bombay Natural History Society*. I visited a Mr. and Mrs. Kilburne who have a house with a garden in the town of Katmandu and Mrs. K. said that a pair of Paradise Flycatchers lived in the garden having made a nest in the same tree for some years. They arrived each year about 30th March, and a friend of hers who had been observing these birds in Calcutta had told her that they arrived in Calcutta on the same date. I said I should like to see them, and after about one minute the birds appeared; the hen with some material in her mouth flew to the nesting tree. This was about 24th April. There were several 'cabbage white' butterflies flying about the garden and one of the birds seized one on the wing and carried it to a perch and there ate it—the wings, which I enclose, fell to the ground. The birds then made several attempts to catch another butterfly. I know birds do eat butterflies—I wrote a letter in 1930 or thereabouts to the *Journal* relating that I had seen the red-legged Falconet catch and eat a butterfly, but the extraordinary part about this incident is that the Paradise Flycatcher carried the butterfly to its perch, not into beak but in its feet like a kite. I was not the only one who saw this; there were several of us in the garden and they all saw it, but it was all done so quickly no one could say whether the butterfly was caught by the bird's beak and transferred to the feet or whether it was caught by the feet of the bird—the white wings showed up vividly under the body of the bird as it flew to the perch.

S. F. HOPWOOD, I.F.S.

C/o MESSRS. THOS. COOK & SON, LTD.,
PHAYRE STREET, RANGOON,
April, 30 1940.

[In the December 1939 issue of the *Journal* (vol. xli, No. 2, p. 445) we published a note by Mr. Hubback on the Paradise Flycatcher eating butterflies: a discussion on birds eating butterflies will be found in the editorial comment to a note on the Red-legged Falconet (*Microhierax eutolmus*) hawking butterflies contributed to the *Journal* by Mr. S. F. Hopwood (vol. xxxi, p. 826). EDS.]

XV.—THE MANY BANDED KRAIT (*BUNGARUS MULTICINCTUS*) IN BURMA.

In his 'Poisonous Snakes of India' Wall remarks that this snake is rare in Burma and that only one specimen has been recorded, somewhat dubiously, from Rangoon.

I was therefore very interested when Mr. L. C. Glass showed me a specimen killed in his garden in Rangoon on May 21st. He says two were seen, but the larger one got away.

The specimen killed had 31 white stripes on the body and 10 stripes on the tail, and was about 2′ 4″ in length.

RANGOON, J. A. M. SYMNS.
May 28, 1940.

XVI.—EXTENSION OF THE RANGE OF THE BROWN WHIP SNAKE (*DRYOPHIS PULVERULENTUS* JAN.)

Dryophis pulverulentus has so far been recorded from Ceylon and the Anamallai Hills, South India [*vide Fauna British India* (Reptilia) p. 371, 1st Ed.]. While on a visit to Karwar, N. Kanara, I secured a male on the 14th September 1940. It measured 53 inches. This, however, is not the first record of this species from Karwar. There is a specimen in the Society's collection labelled 'Karwar' and another, 'Kanara'. Both are without the names of the donors and were collected in 1907. There are other specimens from, Castle Rock (*P. Gerhardt,* 1907); Nelliampatty Hills, S. India (*A. M. Kinlock,* Nov. 1911); Ceylon (*E. E. Green*); and, Matugama, Ceylon (*F. Wall*). Thus it is clear that *D. pulverulentus* is a lot more widespread than originally recorded.

My specimen is of interest as there are some slight differences exhibited by it when compared with the details given in the *Fauna.* In the first place there is a small ovate oblong scale bounded by the internasal, praefrontal and 2nd upper labial. Secondly, the number of ventrals is 195 as against 194 (maximum) mentioned in the Fauna—a very minor difference, indeed. Lastly there are 199 subcaudals as against 173 (maximum). These are all points of minor importance, but, nevertheless, I think, worth recording.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
September 21, 1940.

XVII.—FROG EATING A SNAKE.

I was glad to read Mr. Charrington's note on 'Snake attacked by Frogs' in the Bombay Natural History Society's *Journal* Vol. xli, No. 3, because I witnessed a similar incident a few years ago. It was during the monsoon when I was returning from a dinner party and had just entered my gate, when in the headlights of my car I caught sight of a large frog (*Rana tigrina*) and a snake close to each other on the lawn. I stopped the car keeping the headlights on the frog and the snake, and got down to see what would happen. In a few minutes the frog hopped closer and leaped onto the snake taking hold of it by the neck. The snake which was only 10 to 12 inches long made frantic efforts

to escape but could not release itself from its adversary's grip. When the snake's struggles weakened the frog slowly began to swallow it. I watched this performance for over 15 minutes until nothing but a few inches of the snake still remained. I think the snake was a wolf-snake, a harmless species.

BHAVNAGAR, R. K. DHARMAKUMARSINHJI.
July 8, 1940.

[A number of notes have appeared in the *Journal* on 'Frogs eating Snakes'. In volume xxxvi, p. 161 of the *Journal* McCann records that the Bull-Frog (*Rana tigrina* Daud.) readily devours such small snakes as it can overpower. EDS.]

XVIII.—NOTES ON THE GEOGRAPHICAL DISTRIBUTION AND LARVICIDAL PROPENSITIES OF *HORAICHTHYS SETNAI* KULKARNI.

Observations made on fish fry collected by me from the territorial waters of Cochin and Travancore at Manjummel and Cheranellore in the months of May and June, 1938, have revealed the presence, among them, of larvae of *Horaichthys setnai*, the sole known representative of a new family of fish recently described by Kulkarni (1940, pp. 379-423). Regarding the distribution of the species, Kulkarni records it as occurring in the coastal areas about '100 miles north and south of the city of Bombay'. After the larvae were found, adults were looked for and collected on various occasions from Manjummel and Cheranellore from shallow inlets within tidal influence of the backwaters. It is thus evident that the fish thrives and breeds in the coastal backwaters of Cochin and Travancore. In all probability, the fish extends throughout the western coast of Peninsular India.

Regarding the feeding habits of the fish, Kulkarni lists 'copepods, diatoms, minute crustacean larvae, etc.' as the main items, while he mentions, amidst the stomach-contents of the fish, 'fine particles of sand, pieces of grass, leaves and other debris', which evidently do not form part of its diet. Observations made by me on the larvicidal tendencies of the fish, however, show that it is destructive to mosquito larvae of the first and second instars whenever available. As the fish is small and provided with delicate mouth parts it is more successful in tackling the earlier instars than the later ones. In this respect the fish is likely to prove a valuable adjunct to other major larvivores like *Aplocheilus lineatus* (Job, 1940; John, 1940) and *A. panchax* (Job, 1940*a*) especially in the brackish waters of coastal districts.

The bionomics of *H. setnai*, as revealed from the interesting observations of Kulkarni, are quite favourable for utilising the species in anti-malarial work. While a typical backwater species common in puddles and pools of stagnant brackish-water, and breeding in sheltered places along the edges of the creeks, it extends 'to waters under tidal influence'. Even after the monsoon it is

noted to remain in large perennial pools within tidal limits to propagate the species. Covell's (1935, p. 40) requirements for larvicidal fish are to a great extent satisfied by this tiny toothed carp. Thus (1) the fish is 'small, so that it can get about in shallow water among weeds, etc.' (2) It is hardy, being recorded to be able to withstand a wide range of salinity varying from 4.363 to 1.348 per cent, and can even tolerate fresh-water within limits. (3) It breeds easily throughout the year (with a peak period during July and August). (4) It stands transport very well. A stock stood the train journey from Bombay to Calcutta[1] and thrived quite well thereafter. (5) It is an agile active fish with large eyes which are helpful in locating its prey and in detecting the approach of enemies. (6) It is absolutely insignificant and worthless as food. (7) It is carnivorous as is proved by a study of its stomach-contents as also by its short intestine. The fish is remarkably adapted for surface life. The head, which is flat dorsally and the upturned mouth are suitable adaptations. As Kulkarni has mentioned, the species, like *Aplocheilus,* occurs invariably near the surface of the water and mostly in the midst of aquatic plants, and 'is often found in swarms which move about in close formations'.

Thus it will be seen that *Horaichthys setnai* is a suitable species for use in malarious areas of coastal waters, and its efficiency lies in its capacity to destroy mosquito larvae in their early instars.[1]

T. J. JOB, M.Sc.,
Lady Tata Memorial Research Scholar.

LABORATORIES OF THE ZOOLOGICAL SURVEY OF INDIA, CALCUTTA.

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I. Efficiency. (In the course of publication).

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[1] Mr. Kulkarni kindly gave me some fish to experiment with from this stock which was brought by him to Calcutta, and my thanks are due to him for the same.

XIX.—NOTES ON THE EARLY STAGES IN THE DEVELOPMENT OF THE DECCAN KILLIFISH [*APLOCHEILUS LINEATUS* (CUV. AND VAL.)].

(*With 2 text-figures*)

Introduction.

The sexual dimorphism and breeding habits of the Deccan Killifish, *Aplocheilus lineatus* (Cuv. and Val.) have already been discussed by one of us (Job, 1940). Its egg and a juvenile stage of 14.7 mm. have also been described. Observations on the early devlopment of the fish made from eggs collected from natural habitat are detailed in the present paper. It may be pointed out that from the beginning of this century, when Aitken (1902, cited by Bannerman, 1910, p. 525) observed the larvivorous propensities of *A. lineatus,* the fish has attracted the attention of various workers, and several observations (*vide* Job, p. 52) point to its being of special value in anti-malarial campaigns, especially in the Deccan. Prashad and Hora (1936, p. 643) have emphasized that it is essential, for control measures to be successful, that the biology of the natural agent proposed for control work should be known in all possible details. It is hoped, therefore, that a thorough knowledge of the breeding and development of *A. lineatus* will prove helpful in the culture and use of this efficient larvivore, which is known to be of proved utility in mosquito-control.

In 1910 Willey (p. 122) wrote that *A. lineatus* lays eggs which become attached by glutinous threads to water plants, but added that he had 'not found them so attached', though he had seen them freshly extruded in the month of July. Again, Job's description of the eggs of the species was based on those laid in the month of May, 1938, under artificial conditions of the aquarium in which a few large-sized adult fish were kept.

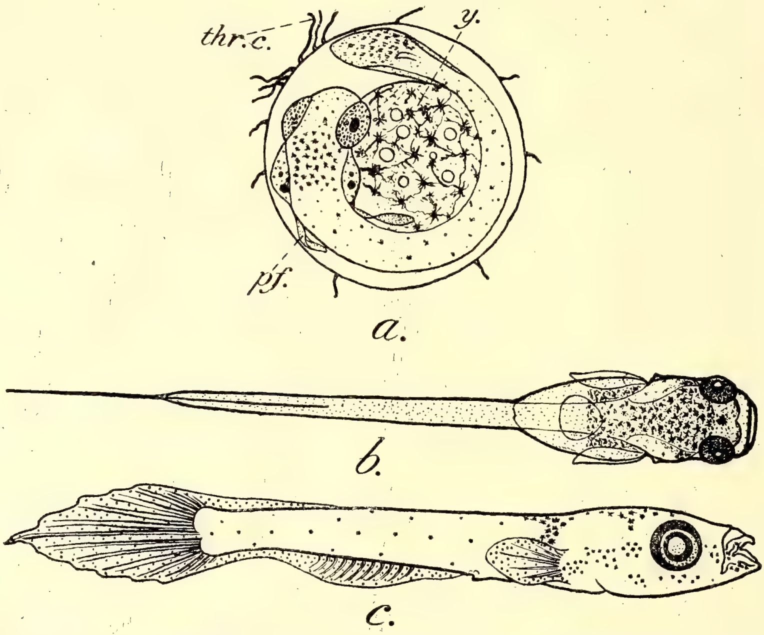
Search for the eggs laid under natural conditions was since then continued. On several occasions empty egg-cases were found attached to water weeds and roots of other aquatic vegetation. Young fry were found in the tanks and ponds in and around Trivandrum throughout the year. Eggs with healthy embryos were collected by one of us (S.J.) from the large tank in the Public Gardens, Trivandrum, in the month of September, 1939 and these were found attached singly to submerged bamboo sheaths near the margin of the tank by the tuft of anchoring filaments, which have already been described in detail by Willey (p. 122) and Job (p. 69). The eggs were carefully transferred to troughs of clean water and their development followed.

Development.

The course of development of *Aplocheilus lineatus* is so similar to that of its North Indian congener, *A. panchax,* which was

recently described by one of us, that only some of the salient features in the development of *A. lineatus* need be described.

Embryonic stages.—The fairly large eggs are transparent during the early stages, but turn brownish as the development proceeds, owing to pigmentation within and accumulation of dirt outside the egg. The period of embryonic development is variable as was observed in the case of *A. panchax*, but usually lasts for about ten days. In the course of development the central mass of oil globules gets broken up, but the Kupfer's vesicle is not distinct as in *A. panchax*.



Text-fig. 1.—Developing egg and early larvae of *Aplocheilus lineatus* (Cuv. and Val.).

a. Six days old egg × *ca.* 22;
b. Newly hatched larva (dorsal view) × *ca.* 18;
c. Larva of twelve days' growth (lateral view) × *ca.* 14;
p. f. pectoral fin, *thr. c.* cut ends of adhesive threads;
y. yolk.

The six days embryo (text-fig. 1 *a*) is well developed with large pectoral fins which are kept in constant motion. The mouth and gill openings are present, the eyes are dark, the vitelline circulation is complete, the caudal fin bears rays and the embryo wriggles actively inside the egg-membrane. The embryo is seen to occupy a greater space within the egg-membrane than that in *A. panchax*. The nature of the hatchling depends on the period of incubation, the quantity of yolk being less in late hatchers.

Metamorphosis.—In general appearance the newly hatched larva (text-fig. 1 *b*) of *A. lineatus* resembles very much that of

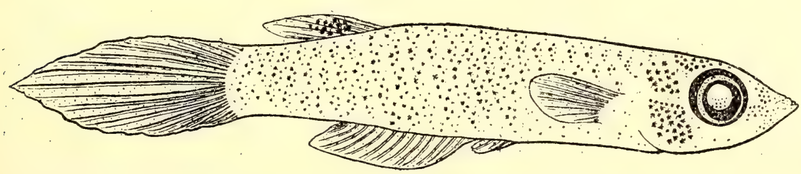
A. panchax, but exceeds the latter in length by about one millimetre. Some yolk-remnant with oil globules is present; the eyes are bright and shining, and the air-bladder is clear. The larva very seldom comes to the surface of the water. The pectorals, though without fin-rays, are large and functional. The caudal, which is lanceolate in shape possesses seven fin-rays, of which the third from above is the longest. All the median fins are continuous, and the dorsal and the anal are devoid of rays. The lower jaw extends slightly beyond the upper. The distribution of pigmentation is very much as in *A. panchax.*

A remarkable feature that has been noticed in the early larva of *A. lineatus* is its capacity to adhere to the smooth vertical sides of the aquarium by the antero-dorsal region of its head for fairly long periods. The usual position is oblique with the tail directed either obliquely upwards or obliquely downwards. Even a very careful examination has failed to reveal any special adhesive organ. Probably the adhesion is effected through adpression. The adhesive habit, however, lasts only for a couple of days after hatching. A more or less similar, though less apparent adhesive habit has also been observed in the case of *A. panchax* (Job, p. 64).

By the second day the larva makes more frequent visits to the surface. The yolk is reduced, the air-bladder becomes larger, and two more fin-rays are developed in the caudal fin.

In another day practically all the yolk is absorbed, and the larva moves about actively, feeding on minute organisms in the water at the bottom and on the sides of the aquarium. The air-bladder grows larger and extends further backwards. The chromatophores on the head turn brownish, while some of those between the eyes acquire a silvery lustre.

The main change that takes place within the next few days is in regard to the fins. The anal fin becomes gradually marked off from the caudal, and rays are formed in its posterior portion, which becomes broader. A week after hatching, the larva has fourteen rays in the caudal and ten in the anal fin. Text-fig. 1 *c* shows a twelve days old larva. It is about 7.5 mm. long. The protractile premaxillae have been protruded during fixation. Beginnings of as many as seven rays have appeared in the pectoral fin, while the number of rays in the anal has risen to eleven.



Text-fig. 2. Post-larva, 11 mm. long (lateral view) × *ca.* 9.

(The magnifications given are those on reduction of text-fig. 1 to half and of text-fig. 2 to one-third.)

Text-fig. 2 shows a fish eleven millimetres long. The anal fin has fourteen rays and the pectoral about ten. The pelvics are well differentiated with the appearance of rays. The dorsal

ocellus is conspicuous. The occipital spot, however, is not yet well formed. This stage represents the final post-larval stage which grows and leads on to the 'young adult', 14.7 mm. long, described in the earlier paper (Job, p. 69).

Summary.

Some of the early stages in the development of *Aplocheilus lineatus* are described. Eyed ova were collected from a natural habitat of the fish and hatched in aquaria. The salient features in the development of the species are more or less similar to those of *A. panchax,* but the Kupfer's vesicle is not distinct in *A. lineatus,* and the developing embryo occupies a greater space inside the egg-membrane. The characters of the hatchling with its peculiar habit of adhering to objects are described. The changes undergone by the larva in its growth up to the 11 mm. size are described. The 11 mm. size represents the final post-larval stage of the fish, after which it assumes the adult characters.

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July 1940.

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XX.—BUTTERFLIES ATTRACTED BY MOIST EARTH.

On page 646 of volume xli No. 3 of the *Journal,* Capt. W. C. Carrot mentions coming across thousands of the butterfly *Appias nero galba* gathered on the sand near a stream. This peculiarity of collecting together in large numbers and sitting on damp spots and sucking up the moisture is a common occurrence with certain families of butterflies, though not of all species of some families. *Troides, Tros, Chilasa, Papilio, Pathysa, Zetides, Paranticopsis, Appias* and *Huphina* amongst others very commonly have this habit. But what is interesting about this habit is the reason for it. Why do these butterflies collect and suck at the damp earth in this way? The places at which they congregate are extremely local and cover a definite area small or large as the case may be,

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[1] For further related literature such as Moody (1939), Stoye (1935), Mellen and Lanier (1935), Fraser (1938) and Innes (1939), see Job, 1940.

beyond which few if any butterflies will be seen sampling the moisture, although the earth or sand has the same appearance as the area on which they are sitting—at least this has been my experience. Moreover day after day butterflies will be found on the same spot but not on others adjacent to it, which have identically the same appearance. Has it ever been investigated what it is in the moisture which attracts particularly butterflies and not other insects, such as flies? I am not speaking of areas where there has been carrion or other dirt but merely plain damp areas in earth or sand. Have samples of the earth where butterflies settle in such hundreds at times ever been analysed to find out if there is any component in these patches which is not found in adjacent areas? Is there some organic substance in the earth which is particularly to their liking or is it some inorganic chemical? Do butterflies visit these spots in the same way that animals visit a salt lick? Furthermore it is only the males so far as I know which behave in this way. I have frequently experimented on a small patch by quietly placing my net over all the butterflies on it and killing them all and then watching the behaviour of other passing butterflies. It was quite apparent that these areas gave off some sort of scent for butterflies, particularly of the genus *Pathysa*, invariably exhibited great excitement when passing close to such a patch although there were no butterflies on it to give any indication of its nature. They would fly backwards and forwards over it after suddenly checking in their flight and finally they would settle—nearly always on the edge of the patch and then flutter and hop with perhaps a short flight or two towards the centre of the patch where they would start sucking in earnest occasionally ejecting drops of moisture from their anal extremities. Gradually more and more individuals would collect until there were as many as before. Another point is that I have seldom, if ever, seen these patches at heights above 3,500 feet where butterflies collect in such profusion as they do at lower elevations, particularly in the hot valleys at the foot of the hills.

Perhaps somebody has taken the trouble to investigate this matter more closely and has come to some definite conclusions. If so it would be very interesting to hear of them from other readers.

Kopji Villa,
Aukland Road,
Darjeeling,
Bengal,
July 15, 1940.

R. E. PARSONS, F.R.E.S.,
Indian Police.

XXI.—ON THE LARVA OF THE MOTH (*CIRCULA TRIPERESTRATA*) AND THE DESTRUCTION OF THE COCOONS BY TREE SHREWS.

On looking through my notes I have come across the following occurrence, which is perhaps worth recording:—

One of the most common larvae to be found in and near Gauhati, Kamrup District, Assam, is that of the moth *Circula triperestrata*

Helfer; where it swarms at times on mango and one or two other trees and shrubs. I have noted two broods in the year; but there are possibly three. The last brood which spins up in about September passes the winter in the pupa and the moths emerge the following May or late April. The moth is seldom seen, although I have found the cocoons by the score and larvae by the hundred.

One morning I was watching a small squirrel-like animal hunting industriously among the leaves of a clump of orchids on a tree in our garden there. It seemed to be finding something very much to its relish and frequently sat up chewing and cracking something which looked like a nut. I investigated and found that the clump of orchids and the leaves of the tree contained numerous cocoons of the moth mentioned, on which the animal had been having a fine feed; first eating a hole through the silk cocoon and then pulling out the pupa which was chewed up in exactly the same way as a squirrel eats a nut. I later shot one of these animals, which were very common, and the Society very kindly identified it as a Tree Shrew, *Tupaia belangeri*. These animals must, in my opinion, unless kept off, cause considerable damage to the larvae of the Muga Silk Moth which are reared on trees in various parts of the District. They also dispose of any cocoons of the Muga which are accidentally left on the trees and I have frequently found empty cocoons of this moth in the Muga 'orchards' with the usual hole in the side. Such cocoons are useless for reeling of course.

Incidentally I sent some *triperestrata* cocoons to an expert who informed me they were useless for reeling purposes being too coarse. The local name of *triperestrata* in Kamrup is 'Amlodie', so I was told.

KOPJI VILLA,
AUKLAND ROAD,
DARJEELING,
BENGAL,
June 23, 1940.

R. E. PARSONS, F.R.E.S.,
Indian Police.

XXII.—*LAGERSTROEMIA INDICA* AS A FOOD PLANT OF THE SILK MOTH (*ACTIAS SELENE*).

I have recently been reminded that some years ago while I was at Sardah, in the Rajshahi District of Bengal, I obtained a female specimen of that beautiful, large, pale green, tailed Saturnid Moth (*Actias selene* Hub.), from which I got about fifty eggs. At the time I did not know what was the most usual food plant of this species and so tried various shrubs and plants from the garden without success until I gave the newly hatched larvae a sprig of that common garden flowering shrub *Lagerstroemia indica* Linn. They immediately began to eat it, and I successfully reared about a dozen to the moth stage. The only thing I noticed was that the perfect insects were somewhat smaller than they should have been.

Perhaps this note may be of use to some of your readers who may be placed in the same position as I was of not knowing what to feed the larvae of this species on. The shrub mentioned is of course exceedingly common in gardens on the plains of Bengal and Assam where it is cultivated for its flowers. A number of the larvae had died of starvation before I gave them the *Lagerstroemia.*

Kopji Villa,
Aukland Road,
Darjeeling,
Bengal,
July 8, 1940.

R. E. PARSONS, F.R.E.S.,
Indian Police.

XXIII.—THE WEEPING WILLOW (*SALIX BABYLONICA*) AS A FOOD PLANT OF THE MOTH (*LOEPA KATINKA* WESTW).

Many thanks for your letter dated the 9th July 1940 regarding my enquiry about the food plants of the Moth *Loepa katinka* Westw. I had found in Seitz that the food plants of this species were stated to belong to the genera *Cissus* and *Leea* and that the larvae would probably also feed on vine. *Cissus* and *Leea* are not available in Darjeeling; I obtained some vine, but they did not appreciate it and only nibbed the edges of the leaves. They began to die fairly soon and before your letter arrived mentioning the food plants of *Loepa newara* Moore, as *Caesalpinia nuga* Aitk., *Salix babylonica* and *Acer Campbelli.* The first named is not available here, so far as I was able to find out. *Acer Campbelli* is very common, but the larvae of *Katinka* would not touch it even. I then tried weeping willow which is *Salix babylonica,* I understand, and they, or rather the remaining 19 larvae, are feeding well on it. This may interest you as you state you have nothing on record as to the life history and food plant of *Katinka.* I got the eggs from a badly battered female which I found on a bush here. She laid a fair number of fertile eggs.

Kopji Villa,
Aukland Road,
Darjeeling,
July 15, 1940.

R. E. PARSONS, F.R.E.S.,
Indian Police.

XXIV.—THE WOOD-CUTTING WASP (*SPHEX EDAX* BINGHAM), AND ITS PREY IN SALSETTE.

According to Bingham [*Fauna British India* (Hymenoptera) vol. i (1897) p. 251] *Sphex edax* has been recorded from 'Sikkim, Tenasserim, Ceylon.' This wasp is not uncommon in the forested areas of the Salsette Island. On 4th March (1940) I caught two

excavating an old, fallen trunk of *Zyziphus* sp., and another was seen on the same trunk. On the 14th April another was caught working on an old trunk. Again on the 12th May I saw one excavating a rotting piece of the trunk of *Erythrina stricta.* All these records were made in the Tulsi Lake area.

S. edax is an extremely active insect and moves about with rapid jerky movements. Its presence in a log is soon noticed by the heap of newly excavated, coarse, wood-dust. On breaking up the *Erythrina* log I noticed that there were several tunnels, some old, some new. The tunnels generally run in the direction of the grain of the wood, and may be several inches deep by about a little more than half an inch wide. When the tunnel is complete the provender for the future young is deposited at the far end and then the cavity is plugged with wood-dust for a distance of two to three inches. The wood-dust is packed tight. At the end of one of the tunnels I found five or six black, flightless cockroaches, [1]*Perisphaeria* sp. The cockroaches were alive, but in a stupefied condition. It is well known that some members of the *Sphegidae* collect *Orthoptera* for storing in their homes.

In life, the general colour is shining black, except for the abdominal segments which are bright red; but in the preserved state the bright red fades to dull-red or red-brown. The wings are an irridescent blue-black, somewhat like those of a scolid.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
May 13, 1940.

XXV.—LARVA OF *THERETRA LYCETUS* CR. PARASITIZED BY TACHINID FLIES.

On the 14th July (1940) while scouting round for entomological specimens in the jungles just off the road between Bapsai and Murbad, Mr. J. Alfrey spotted a large larva of *Theretra lycetus* Cr. feeding on a species of *Leea* (Vitaceae). As the larva appeared quite healthy we brought it home in the hope of getting the moth. I kept it in a case. The next day the caterpillar left the leaves and moved round as though looking for a place to pupate. On the 16th it changed colour from green to brown and lay in a corner—pupation seemed inevitable. On the 17th morning I found the caterpillar dead in the centre of the cage. It appeared rotten as it had burst and was liquefying. Inside the body was a heaving mass of several fly maggots. On the 19th no trace of the maggots was to be seen; only the skin of the caterpillar remained lying on a damp patch of earth. On the 29th three flies appeared in

[1] I am indebted to Dr. Baini Prashad for the identification.

the morning and another in the afternoon. The next day a fifth fly had emerged. On the 1st August as there was no addition to the flies I opened the case, after killing the flies, and examined the earth under the caterpillar. The pupal cases of the flies could be clearly seen just where the skin of the host was lying. The mud had become a compact mass—as a result of the putrefying liquids filtering into it, and in this were buried the pupal cases of the flies with the tops just showing at the surface. A single pupa which was apparently dead was also found which brought the total number of flies to six. These observations give the pupal life of the flies as approximately ten days.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
August 1, 1940.

XXVI.—MARCH *LEPIDOPTERA* AT GOPALPUR (DIST. GANJAM).

The following is a list of species taken in the course of a month's very superficial collecting in March 1940. The list is obviously far from complete and most of the species recorded were taken in the Casuarina jungle surrounding the Yatton Hall Hotel. The Heterocera recorded as being taken at light were caught in the Hotel itself.

RHOPALOCERA.

Polydorus hector L.—About the commonest butterfly. Also larvae.
Polydorus aristolochiae F., *aristolochiae*—Common. Also larvae.
Papilio paris L., *paris*—Common.
Papilio polytes L., *romulus* Cr.—Uncommon.
Papilio demoleus L., *demoleus*—Uncommon.
Delias eucharis Drury—Uncommon.
Cepora nerissa F., *phryne* F.—Common.
Anapheis aurota F., *aurota*—Common.
Catopsilia pomona F.,—Common. Also f. *bidotata* Fruhs.
Danais plexippus L.—Common.
Danais chrysippus L.—Not uncommon.
Euploea core Cr., *core*—Very common.
Melanitis leda L., *ismene* Cr.—One specimen.
Euthalia garuda Moore, *anagama* Fruhs.—Common.
Hypolimnas misippus L.—Common.
Hypolimnas bolina L.—Common.
Precis orithya L., *swinhoei* Btlr.—Uncommon.
Precis lemonias L., *vaisya* Fruhs.—Not uncommon.
Atella phalanta Drury—Not uncommon. Also larvae.
Ergolis merione Cr., *tapestrina* Moore—Not uncommon.
Telchinia violae F.—Very common.

Cosmolyce boeticus L.—Very common.
Spindasis ictis Hew., *ictis*—Common.

HETEROCERA.

Ocinara varians Wlk.—One specimen.
Cephonodes hylas L., *hylas*—Common. Also larvae, mostly a dark form.
Macroglossum gyrans Wlk.—Larvae not uncommon.
Lymantria ampla Wlk.—Dead pupae common, and one larva on Casuarina.
Porthesia scintillans Wlk.—One larva.
Perina nuda F.—One female at light.
Asota caricae Bsd.—A batch of young larvae.
Utetheisa lotrix Cr.—Very common.
Philagria entella Cr.—One male at light.
Agrotis spinifera Hbn.—At light, not common.
Sideridis percussa Btlr.—At light, not common.
Prodenia litura F.—At light, not uncommon.
Spodoptera mauritia Bsd.—At light, not uncommon.
Schoenobius bipunctifer Wlk.—At light, not uncommon.
Sameodes cancellalis Zell.—At light, uncommon.

CALCUTTA, D. G. SEVASTOPULO, F.R.E.S.
August 3, 1940.

XXVII.—SOME INSECTS FROM A MANGO TRUNK (*MANGIFERA INDICA* L.).

Just outside my compound wall at Andheri, Salsette Island, there is a mango tree which showed signs of withering.[1] On inspecting it I found that the trunk and branches were riddled with holes, evidently the work of *Batocera rubus* L. On one of the branches was a lively nest of the Brow Tree-Ant (*Cremastogaster rogenhoferi* Mayr.) not far from the original seat of attack. The ants were constantly moving about, and a Bloodsucker (*Calotes versicolor* [Daud.]) sat on the stem daily and 'lapped' them up as they passed near. Closer examination of the trunk revealed that the bark had split in several places. The underside of the bark had been destroyed and the space was packed tight with excreta and wood shavings. The bark was quite lose and came away easily, leaving much of the 'packing' *in situ*. In several places under the bark the ants had established themselves. In some of the large holes I found Elaterid beetles (*Agrypnus* sp.) resting on their head as though they had fallen dead and had slipped down towards the entrance, but they were quite alive—waiting for nightfall to take off.

Under the bark I found five pairs of the Brenthid beetle,

[1] The tree has since died.

Orychodes sp. These beetles were always in couples. Besides the Brenthids there was a single specimen of a Cucujid beetle, *Hectarthrum heros* F. (?), and several small larvae and pupae of other *Coleoptera* which I cannot place. On opening the bark, the ants immediately took possession of all other insects, but I soon deprived them of many of their spoils. In the packing of excreta there were numerous Book-Scorpions, *Chelifer* sp., in various stages of development, but these were more frequent where the refuse was damp. In spite of the presence of ants, life goes merrily on under the bark.

In volume xli, p. 678 of the *Journal* I recorded the presence of Book-Scorpions under the wings of *Batocera rubus*. At the time (November-December) several specimens invaded the house at night, being attracted by the lights. Later in March, the Brenthids came in, but sporadically; and yet later the Elaterids appeared from time to time in rather unusual numbers. As the drying mango is about forty feet from the verandah, it is evidently the home of the insect invaders.

Of these insects *Batocera* is known to attack mango trunks; the food of the Click-beetle appears to be uncertain; the Brenthids seem another unknown quantity as regards their diet, though it is presumed they are wood-boring: the Cucujid is a carnivorous beetle and feeds on other insects and larvae.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
May 12, 1940.

XXVIII.—INSECTS AT A STREET LAMP AT ANDHERI.

The desire to predict an event is common to most people, but how often do our calculations turn out as predicted? During the sweltering heat of the hot weather there are many prophets abroad anxious to forecast the break of the rains—even the Press indulges in a bit of fortune-telling! For the past weeks speculation had run high, but Nature pays little heed to mere human calculations, it generally upsets them, and so it was with the break of the rains in 1940. Heavy rain fell on the 3rd June. Some people insisted that the monsoon had burst, others held that it was just a storm. In fact, weather conditions were rather abnormal this year. Animal life is greatly dependent on weather conditions and accordingly in abnormal years animals also behave 'abnormally'. The fact was betrayed by the arrival of certain insects out of season; for example, certain Cantharids, which are abundant in August and September in Salsette, arrived in the latter part of April—much before their usual time. Turning to the ornithological field, a pair of Dhayals [*Copsychus saularis* (Linn.)] had brought up a family in a dead Date Palm, by the end of May. The young were on the wing—rather early for these birds in this area. Also, in the botanical field, an Aroid (*Amorphophallus commutatus* Engler) had miscalculated too. It came into full bloom before the end of May, before any rain

had fallen. This species usually blooms only soon after the first showers arrive. Nature seemed upset! Heavy rain continued to fall for a couple of days and all Nature responded to the climatic change.

The sky on the night of the 5th was almost cloudless, the ground was sodden and the temperature sticky. Millions of insects had waited for the rains to be released from their pupal stages, and take to wing on perhaps, life's last mission to reproduce or die as food for others. It was an exhibition of the struggle for existence. This struggle is, perhaps, never keener at any other time of the year than at the break of the monsoon. Life at this time is just one enormous 'tidal wave'. I took my stand under a street lamp at Andheri—a naturalist on the prowl, complete with net and sundry killing bottles.

The ground around the lamp post was teaming with large, winged ants. They had just emerged from the ground and gathered round in clusters, bidding farewell to their late home and taking leave of their 'nurses'—it was time for the marriage flights—the last flight for them all, some to fall victims to their fate, others, but few, to start a new colony. Away from their birth place they were now to brave the dangers of a new adventure. The lamp had attracted thousands of other winged ants, and conspicuous among them were *Camponotus* and *Cremastogaster*. The presence of the new arrivals did not seem to worry the groups on the ground; none were in a fighting mood, though at any other time the ants would never have tolerated such familiarity. The flying termites had appeared earlier in the evening, and by 9 p.m. were no longer around the lamp.

The air around was alive with insect forms, so numerous that frequent collisions brought many to the ground dazed. Small moths were in plenty, and a few large *Euproctidae*, all vainly trying to reach the burning filament. The magnetism of the light held them. Doom awaited most of them. Now and again a cricket would kick itself into the air, take to wing for a while and then fall clumsily to earth, to kick off once more when disturbed by another insect. The whir of thousands of small wings, the constant metallic click from the lamp shade and the dull sound of a fall to the ground, were from time to time interrupted by the deep drone from the wings of some large coleopter. The zooming noise was soon followed by a crash against the light or the post, then a thud which announced that the beetle had landed on its back, and finally a shuffling sound as it made frantic efforts to right itself. Success meant a new assault on the bewildering light. All these sounds betrayed the arrival of one of the largest of the Longicorns, *Acanthophous serraticornis* Ol., quite a formidable name for a formidable looking beetle with large punishing jaws. A suitable hold on the back soon puts its 'armaments' out of action. Before I decided to retire I had secured sixteen fine specimens—five others had been crushed by passing vehicles. This was an exceptional flight, for, in all the years I have been at Andheri, I have never known this species to appear in such numbers. Subsequent enquiry showed that the flight was rather general, for

the longicorns had been seen by many other people in Andheri.

At times wayfarers stopped and took stock of me, perhaps wondering what on earth the 'sahib' was doing at that hour of the night under the light, covered with insects, and armed with a butterfly net and several bottles. They watched me, and when they saw me make a dash for this or that insect and quickly consign it to one of the bottles, they were satisfied, though curious as to what would be the fate of the insects—were they eatable or medicinal? Any way they evidently doubted my sanity and moved off commenting. They were villagers and did not understand. Motorists hooted at me as I hastened across the road to retrieve a specimen; heads popped out to have a look—the general consensus of opinion must have been—a lunatic at large! It was not the first time that my identity and intentions have been mistaken. When following natural history pursuits, I have been often pitied as a case more suitable for a mental asylum! A naturalist must be prepared for such comments from the uninitiated, but let me return to my lamp and its fauna.

Insects spell food for many animals, so I soon discovered that I was not the only watcher under the light. The recent rain had deluded the Bull Frog (*Rana tigrina* Daud.) from its retreat. They had come up to breed, but the rain was insufficient for breeding purposes, so they hopped about the countryside in a vain search for puddles. The chorus of their sonorous voices lifted in 'prayer' for more rain, was in vain. Some of them were in their wedding garb of yellow, but not as bright as it should be—a dirty greenish yellow. Though not quite intent on food at this time, they still 'lapped' up an insect here and there. Some of the unfortunates had been run over by cars—an enemy Nature had not counted on—and were now just 'grease spots' or mangled forms. On the lamp-post were a couple of geckoes (*Hemidactylus flaviviridis* Rüppel). They had soon eaten their fill and now looked longingly at the insects they could not eat. What would they have not given for a more elastic stomach! At last, tired of looking on at the feast before them, and the constant rain of falling insects on their bodies, they decided to move off. The ground was alive with spiders, large and small, preying on the insects as they fell. Among the spiders was a single *Mygale*. The spiders too were constantly disturbed by the rain of insects, which made them retire to suck their meal in peace. Sneaking along the edge of the drain was a shrew (*Suncus* sp.) with its long snout vibrating like the free end of an agitated spring, seeking this or that 'dainty'. Now and again it would make short sallies into the arena, seize an insect and retreat to make a meal of it, only to return for another. A little way off a gentle crackling noise drew my attention, so I switched on my torch to discover a Bandicoot (*Bandicota malabarica* Shaw) gnawing at a big Longicorn (*Batocera rubus* L.) The bandicoots lurked in the shadows, and seldom came into the light. Several centipedes (*Scolopendra* sp.) moved about in the throng of insects in the drain taking toll here and there. There were numerous carabid beetles

(*Pheropsophus catoirei* Dej.) hurriedly seizing their prey and retiring immediately to deal with it. How many other insect feeders were lurking around, is difficult to imagine. Some bats occasionally visited the light, but there was evidently enough food in the air without hovering round lamps.

Flying ants seemed to predominate. Beetles, perhaps came next in numerical order, most of which were minute. Of the less minute forms the cockchafers (*Melolonthidae*) were there in their hundreds. The *Carabidae* were well represented particularly by a black species commonly found under stones. A straggler among the *Coleoptera* was a Rhinoceros Beetle (*Oryctes rhinoceros* L.), but its life was short for a passing car reduced it to a 'flat skin'. The moths were well represented by a large number of *Microlepidoptera.* Among the larger forms were specimens of *Euproctis* sp. and a few of the peculiar family *Hepialidae,* moths with long heavy bodies and clumsy flight (*Phassus* sp.). The *Orthoptera,* grasshoppers and Grillids, were fairly plentiful. The mole Cricket (*Gryllotalpa* sp.) a member of the 'under world', also hung around. The *Rhynchota,* or garden bugs and members of the *Homoptera,* mostly minute, were present in goodly numbers. A curious point about the Cotton Bug (*Dysdercus cingulatus* Fab.) is that though during the day thousands are about in the neighbourhood, very few were attracted by the light.

Near midnight I decided to retire; so I collected my belongings and went to bed after ridding myself of as many insects as I could. Next morning I visited the scene of the previous night, but there was nothing to betray the activity that had taken place. On arrival at the office with my 'bag', the insect department foresaw a busy day, there were over a hundred specimens to set. Of course, I could have multiplied this figure an hundredfold, but it would have meant much duplication.

It will not be out of place to compare the catch of this night with that of the next. Except for a considerable reduction in flying ants, most of the insects mentioned above were there. There was a noted increase in the number of cockchafers and scarabs. Of *Acanthophorus* only one turned up. A pair of beetles closely allied to *Acanthophorus* was also secured. They were *Macrotoma crenata* Fabr. This was the first time I secured this cerambycid in Salsette. Small mantids were occasional. As the weather was drier the frogs seemed fewer in numbers. The shrew was back accompanied by friends; the Bandicoot lurked in the shadows.

The 'Dance of Life' around a street light at the break of the rains and for some time after is mingled with jubilation and tragedy. Jubilation because it is the setting free of millions from the pupal life, tragedy because the majority perish—they have hardly begun life when it is snatched away from them.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.

BOMBAY,

June 7, 1940.

XXIX.—SOME INDIAN SPIDERS: THEIR SEASON OF PROSPERITY.

As a class spiders occur throughout the year. There are, however, certain periods when they are at the height of their prosperity. Ecological experience reveals that, in India (especially Western India) the best part of the year for spider collection is during the few months following the rainy season. It is now most of the families of spiders are active and industrious. The scorching summer seems to be a time of distress to them. So also the torrential rains dwindle their number to an appreciable extent by washing away their delicate webs.

There are certain factors that favour the growth of spider population during the period after rainy months and before intense summer.

With a few exceptions spiders are in general moisture-loving creatures. Many of them are arboreal and wholly dependent upon plants for their abode. In India the real 'spring' season is soon after the heavy rains. The vegetation is exuberant during August and September. The increase in vegetation and the recession of destructive rains afford ample facilities for these animals to construct their webs among the plants and peacefully propagate their species. Food also is in plenty during this season. Attracted by the numerous wild flowers which appear now, insects like bees, and flies come to the plants in large numbers and get easily entrapped in the spiders' webs.

The following are some of the common families of spiders which prosper during the season referred to.

Among the arboreal groups of spiders the most important family that flourishes during the months of September and October is that of the Argyopideae. Attached to the boughs and branches of trees the giant wood spiders (*Nephila maculata*) are busily engaged in constructing their extensive snares. Along fences and thickets the beautiful *Argyope* thrives. Wherever there is vegetation the garden spiders (*Epeira diadema*) are present in hundreds, very active building their delicate webs. Walking along an open country side, during evening time, a collector can see numerous members of *Argyroperians*, *Araneus*, *Tetragnatha* and other Argyopids carrying on their web construction in full swing. These spiders remain a feature of every country part throughout the cold season. With the approah of summer, however, when the atmosphere is no longer hygroscopic but dry and the annual vegetative growths parched, the Argyopid community also dwindle little by little and confine themselves to the 'greens' by the margins of pools, tanks and rivers or other moist localities.

Oxyopideae, which generally live among grass and other small plants, increase and decrease in population with the growth of such plants after the rains and their drying away in summer. During summer many Oxyopids shift themselves to the watered fields of rice and other cultivation. A great number of them is however destroyed during the summer harvest. May, June and July are months of famine for them. Only with the onset of

the following monsoon and the reappearance of grass in the lawns do they revive.

Closely allied to the Oxyopids in their habits are the Psechrids. They can be easily distinguished from the former by their difference in shape, the extraordinary length of the anterior two pairs of legs, and the absence of spines on the body. With the increase of grass and other plant growths during monsoon and after, these spiders also multiply and spend their days among axils of leaves or spikes of grasses. They are extremely common among the inflorescence of Cyperaceae and Amaranthaceae. Just as the Oxyopids they also decrease in number with the withering away of vegetation and resort to the scanty flora in damp localities during summer.

Of Sparassideae and Clubionideae, the former seems to have more liking for moist conditions than the latter. Sparassids like *Palystes* and *Sparassus* are very fond of broad and succulent leaves for the construction of their patch like webs. During the monsoon, and prior to the advance of sultry weather and the consequent dwindling down of wild plants, they thrive in large numbers everywhere. In summer, however, there is marked decrease in their number, and they are only found on the leaves of watered garden plants like Cucurbita, Water-melons, Plantain suckers, etc.

The Clubionids also present seasonal variation and the members found in the monsoon time are healthier and larger than the summer brood. From the fact that many Clubionids reside among green leaves there is reason to believe that they have a liking for moisture.

Herseliids also seem to thrive better under moist conditions rather than in the height of summer. During the months of August and September we find plenty of them on the bark of trees—trees with fissured bark like *Pithecolobium saman*, mango trees, etc. During the hot season their number shows a definite reduction. There are however certain species which are found on old dry walls and which thrive equally well both in summer and in winter.

Pholcids, tender, long-legged spiders found in the roofs and rafters of old houses do not seem to be affected by seasonal variation.

Many Attids or jumping spiders also prosper unaffected by change of season; but those species which hunt among vegetation are affected in a similar way as the Oxyopids and Psechrids.

With a few exceptions the entire group of Lycosids require moisture for thriving. Shortly after the rains they are abundant among the low-lying, water-logged parts of any compound. They always like cool places and therefore they distribute themselves in damp and moist localities, beside water, among putrefying dead leaves and rubbish on open grounds, under stones and in damp soil. In moist fields, laid fallow, their number is enormous. During winter mornings, thousands of their patch webs can be seen on open lawns, and the members themselves running here and there with great agility. With the advent of summer they diminish in prosperity and get confined to moist areas beside fields and pools.

Eresids seem to be common during winter and summer alike.

The webs of the Indian colonial Eresids—*Stegodyphus*—are found to remain intact for more than two years and the members are active throughout the period.

Although spiders, as a group, are described as ubiquitous, Nature has her own influence upon their community. Spiders withstand climatic and seasonal variations to a greater extent than many other lower animals. They persist through Spring, Summer, Autumn and Winter; but it needs be mentioned that moist conditions are preferred by most of them.

More careful and perseverant field work will surely reveal more facts about the 'life of spiders'. The 'breeding time' of spiders is also an interesting subject for further exploration.

BOMBAY, T. V. SUBRAHMANYAM.
September 13, 1940.

XXX.—THEFT OF A WATCH BY A FIDDLER CRAB.

This is a story told by an Ajman Badawin to Lt.-Col. H. R. P. Dickson on 25-6-40 of the wonderful tracking powers of all members of the Murra tribe, and in the presence of one Muhammad al Murri.

'Muhammad al Murri, before he came along to the K. O. C. guards hut at Burgan, had been staying with Sheikh Sabah al Nasir as *subah* at his camp at Mungaf near the sea shore. One day Sheikh Sabah's motor driver complained that his wrist watch had been stolen from him while he was having a bathe. He explained how that the tide was going out when he went down, and he undressed and put his clothes on the sand and his wrist watch with them, and went into the sea. He had not noticed anyone come along the shore although he had not paid much attention. When he came out and got dressed he found his watch had completely disappeared and there was no sign of it anywhere.

Muhammad al Murri was present in the tent and heard the story. The driver did not ask him to find it for him or say anything to him.

Shortly afterwards, the Murri, being rather interested, walked down to the shore. The tide was now lower, but quite easily he found the place where the clothes had been put on the sand, and around which, and to and from it, down to the water were the driver's foot marks. After wandering about for a bit he could see no trace of any other human being having been near, the only marks there were, were those of crabs which had been running about on the sand along the shore. One track which he noticed, came towards where the clothes had lain, but he did not think anything of this, and came to the conclusion that the driver was a liar, and had himself lost his watch on some previous occasion. The Murri then returned to camp.

Next morning however, he again went down to the same spot. This time the tide was high, and all marks had gone. He sat

down near the shore and waited till the tide went out a bit, and until one by one the crabs came out of their holes and began to run around on the sand. (I might add here that these are rather small crabs with one claw much larger than the other, and they each build a sand tower just on one side of their hole.)

The Murri then walked down towards them, and they all disappeared rapidly into their holes. After looking at their tracks for a bit, he suddenly recognized from among them all, the track of the one which he had seen the previous day in the vicinity of the spot where the driver's clothes lay. He followed it carefully for about 100 yards to its hole. He then began to dig, and sure enough, down its hole he found the wrist watch.'

This I know is a true story. The point of the story is, that to any ordinary individual all crab tracks would appear the same. Yet the Murri had been able to distinguish the track of a particular crab which he had seen the previous day, from among many dozens of others.

Since this happened, Muhammad al Murri was sent for by the Military Governor of Kuwait, Sheikh Ali al Khalifa, to discover the thief in a robbery case. This case is still in progress, but the foot-prints in the sand round the tent were identified by him. It will be interesting to see if he is correct.

Note.—The Murra tribe is famous all over Arabia for their wonderful tracking lore. They inhabit the northern edge of the Rub'—al Khali.

KUWAIT, PERSIAN GULF, VIOLET DICKSON.
July 6, 1940.

PROCEEDINGS OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY.

The Annual General Meeting of the Society was held at the B. E. S. T. Lecture Hall, Electric House on Thursday the 18th April 1940 at 6-15 p.m.; Rt. Revd. R. D. Acland, M.A., presiding.

AGENDA.

1. Reading of the Annual Report of the Committee.
2. Presentation of the Balance Sheet and Statement of Accounts for the past year.
3. Election of the Committee.

The Honorary Secretary announced the election of 33 new members since the last meeting held on 18th April 1939:—

Mrs. Camar Tyabji, Bombay; His Highness the Marawat Sir Ram Singhji Bahadur, K.C.S.I., Partabgarh State; Mr. M. Zinkin, I.C.S., Sholapur; H. H. the Maharaja Jagaddependra Narayan Bhup Bahadur, Cooch Bahadur; Maharaja Pateshwari Prasad Singh of Balrampur, District Gonda, Oudh; Mr. C. G. Baron, Shillong; Mr. N. D'O. Finnis, Quetta; Mrs. C. M. Van Allen, Bombay; Mr. H. E. Ormerod, Bombay; Mr. J. Lockhart, Bombay; Mr. A. G. Sandeman, Meerut; Mr. J. S. Anderson, Bombay; Major Allen Block, Allahabad; Mr. Q. F. Rahman, I.S.E., Moradabad; Mr. B. L. Rawat, M.Sc., Ph.D., Ajmer; Mr. V. M. Vasu, Porbander; Mr. M. St. J. Kelly, Lohardagar, B. N. Ry.; Mr. B. W. Budd, I.C.S., Mirpurkhas; Mr. E. C. Cameron, Nilgiris; Mr. B. F. Patuck, Bombay; Mrs. M. D. Wright, Amraoti; Mr. D. Nilsson, Bombay; Mr. T. J. Phillips, Waziristan; Major F. H. W. Ross-Lewin, Bombay; Major W. L. D. Veitch, R.E., Roorkee; Mr. John Leslie, Calcutta; Mr. F. Potter, Bombay; His Excellency Sir Maurice Hallett, K.C.S.I., C.I.E., I.C.S., United Provinces; His Excellency the Governor of Bengal; Major J. M. Bruce-Steer, Bombay; Capt. Jafferali Khan G. Agha, Dharwar; His Excellency the Governor of Madras; Major R. C. Nicholas, Poona.

BOMBAY NATURAL HISTORY SOCIETY.

OFFICE BEARERS—1940.

The following gentlemen were elected to serve on the Managing Committee for the ensuing year:—

President.—H. E. Sir Roger Lumley, G.C.I.E., D.L.

Vice-Presidents.—H. H. The Maharao of Cutch, G.C.S.I., G.C.I.E.; Rev. Fr. J. F. Caius, S.J., F.L.S.; and Rt. Revd. R. D. Acland, M.A.

Executive Committee.—Mr. Salim A. Ali, Mr. Farrokh E. Bharucha, Mr. A. Ferrington, Mr. T. B. Greaves, M.L.A.; Mr. M. J. Hackney, Mr. R. E. Hawkins, Mr. D. G. Hill, Dr. M. Shariff, D.Sc., Ph.D., F.L.S.; Lt.-Col. W. C. Spackman, I.M.S.; Lt.-Col. S. S. Sokhey, I.M.S.; Mr. F. Wadia, and Mr. H. M. McGusty (*Hon. Secretary and Treasurer*).

Advisory Committee.—Dr. C. F. C. Beeson, D.Sc., M.A., I.F.S.; Lt.-Col. R. W. Burton, I.A., (Retd.); Mr. C. H. Donald, F.Z.S.; Dr. F. H. Gravely, D.Sc.; Mr. C. M. Inglis, B.E.M.B.O.U., F.Z.S.; Mr. R. C. Morris, F.R.G.S., F.Z.S.; Major E. G. Phythian Adams, F.Z.S., I.A. (Retd.); Dr. Baini Prashad, D.Sc.; Mr. H. C. Smith, I.F.S.; Lt.-Col. C. G. Toogood, C.I.E., D.S.O.; Mr. J. H. Williams.

Staff.—S. H. Prater, M.L.A., J.P., C.M.Z.S. (*Curator*); and C. McCann, F.L.S. (*Assistant Curator*).

The proceedings concluded with an interesting lecture by Mr. S. H. Prater on 'Camouflage in Nature and in War'.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31ST DECEMBER 1939.

ADMINISTRATION.

President.—H. E. Sir Roger Lumley, G.C.I.E., D.L.

Vice-Presidents.—H. H. The Maharao of Cutch, G.C.S.I., G.C.I.E.; Rev. Fr. J. F. Caius, S.J., F.L.S.; Rt. Revd. R. D. Acland, M.A.

Executive Committee.—Mr. Farrokh E. Bharucha, Mr. A. Forrington, Mr. J. B. Greaves, M.L.A.; Mr. M. J. Hackney, Mr. R. E. Hawkins, Mr. D. G. Hill, F.R.G.S., J.P.; Lt.-Col. W. C. Spackman, I.M.S.; Lt.-Col. S. S. Sokhey, I.M.S.; Mr. F. Wadia, Mr. H. M. McGusty (*Hon. Secretary and Treasurer*), Bombay.

Advisory Committee.—Dr. C. F. C. Beeson, D.Sc., M.A., I.F.S., Dehra Dun; Lt.-Col. R. W. Burton, I.A., (Retd.), Bangalore; Mr. C. H. Donald, F.Z.S., Dharamsala; Dr. F. H. Gravely, D.SC., Madras; Mr. C. M. Inglis, B.E., M.B.O.U., F.Z.S., Darjeeling; Mr. R. C. Morris, F.R.G.S., F.Z.S., Coimbatore; Major E. G. Phythian Adams, F.Z.S., I.A., (Retd.), Nilgiris; Dr. Baini Prashad, D.SC., Calcutta; Mr. H. C. Smith, I.F.S., Maymyo; Lt.-Col. C. G. Toogood, C.I.E., D.S.O., Fort Sandeman; Mr. J. H. Williams, Coimbatore.

Staff.—S. H. Prater, M.L.A., J.P., C.M.Z.E., (*Curator*); C. McCann, F.L.S., (*Asst. Curator*).

THE HONORARY SECRETARY'S REPORT FOR THE YEAR 1939.

The Society's Journal.—The Fortieth Volume of the *Journal* was completed during the year and two numbers of Volume xli were published.

MAMMALS.

Mr. Theodore Hubback contributed an interesting article on the Asiatic Two-horned Rhinoceros (*Dicerorhinus sumatrensis*). His note, based mainly on personal observations, summarises what is known about the habits of this rhinoceros, the terrain in which it is found, its food, and the many legendary beliefs and superstitions attaching to the species. Mr. Hubback's paper is supplemented by additional notes by Mr. S. H. Prater on the genera, species and races of the Asiatic Two-horned Rhinoceros, as described by various authors. He summarises the available data regarding the external physical characters of the species and discusses the basis of the various beliefs and legends recorded by Mr. Hubback. Of general interest is the theory that traces the origin of the unicorn, from which the rhinoceros inherited its fabled attributes, not to a four-footed beast such as the oryx, or the wild ass but to *Cerastes*—the Horned Viper, which figures prominently in Assyrian and Hebrew Religion and Art, and which poetic fervour and imagination endowed with wings, limbs and claws. If the poisonous viper gave origin to the belief in the Unicorn—then the supposed efficacy of the horn of the Unicorn, and of its successor the Rhinoceros—against poison is associated with the ancient well-known belief that poison counteracts poison; while the fabled power of a virgin over the unicorn and the rhinoceros may be traceable to 'the Woman's domination over the Serpent' proclaimed in the Bible. These wondrous attributes have passed from the Horned Viper to the unicorn and from the unicorn to the rhinoceros.

Mr. Hubback's article ends with a plea for the more rigid protection of the rhinoceros, which is now on 'the threshold of extinction'. Its extermination must inevitably result from absence of undisturbed conditions, which is now the case. A species, which has survived from past geological epochs to our day, is finding itself unable at last to withstand the intrusion of modern Man into its domain. The only hope that remains of saving these animals from extinction in Malaya and Burma, adds Mr. Hubback, is to constitute inviolable sanctuaries in their own habitat, where a suitable environment is known to exist. An appropriate pendant to Mr. Hubback's comment is Mr. D'Arcy Weatherbe's memorandum on the Kahilu Sanctuary in Burma, which deals with the reports of the survival of the rarest of all Rhinoceros—the Lesser One-horned Rhinoceros (*R. sondaicus*) within its limits. In 1929 a fragment of a skull and in 1933 a complete skull, both of which undoubtedly belong to this species, were obtained in this area and presented to the Society. Mr. Weatherbe shows that genuine evidence is lacking of the continued existence of this rare rhinoceros in the sanctuary. Further, he makes clear that terms and conditions under which this sanctuary has been established render ineffective what might otherwise have been a permanent and valuable refuge for wild life. In the present temper of the legislatures the possibility of enacting suitable legislation for the establishment of inviolable Sanctuaries appears remote. Nevertheless such sanctuaries are a *sine qua non* and the present half measures introduced by Government will do little to achieve their purpose. An offset to this sorry position is the record of the work of the Nilgiri Game Association—1879-1939 by Major E. G. Phythian Adams. The Association is to be congratulated upon its achievements during the 60 years of its being. The result of its activities show what can be done by private effort, when proper official backing is forthcoming. Sambhar and chital in the areas controlled by the Association have not only maintained their numbers but have very appreciably increased, while the Nilgiri Tahr, reduced to a bare dozen when the Association was formed, now exceed 500 head. Starting with a fauna, in the case of some species, on the verge of extermination, the Association has by careful control built up as fine a stock of game as is to be found anywhere in India. The recent action of the Madras Government asking this Association to surrender half the shooting and fishing fees, is therefore all the more to be deplored and, if insisted on, will impair considerably the Association's efforts and reduce to impotence what is perhaps the most successful organization of its kind in the East. It is hoped that wiser counsels will prevail, and that the Association will continue to receive in full, the support which it deserves.

Birds.

Among the many notes and articles on Indian Birds is Mr. Sálim Ali's Report on the Birds of Central India which is based on surveys carried out in the Central Indian States of Bhopal, Gwalior, Indore and Dhar. The financial grants generously proffered

by the Governments of the States concerned have made this valuable work possible. The area covered by the survey had not been systematically studied previously. While no fresh discoveries were expected, the material collected provides useful data for determining the racial status and distribution of species in correlation with parallel data obtained in surveys carried out in other provinces of India. Mr. Ali has done his work with his usual efficiency and thoroughness. We have once again to thank Mr. Whistler for his work on the material obtained. We should like to take this opportunity to express our sorrow and our sympathy with Mr. Ali on his recent loss. The death of his wife has removed from his side a comrade who shared in his work, braving the discomforts that attended it, to give him her help, care and companionship.

Central Indian bird life features again in Mr. C. E. Hewitson's 'Bird Year in Betul' which presents a picture of the bird life of the district from month to month and provides a model which other students of local faunas might well follow.

With the publication of Part VI, the serial by Messrs. Sálim Ali and Humayun Abdulali on the Birds of Bombay and Salsette is concluded. The work has been generally commended. It provides students and laymen not only with an up-to-date working list, but with a readable and interesting account of the local bird life, deriving much of its merit from well written descriptions of the breeding and general habits of the species. As previously indicated, it is intended to publish the serial in pamphlet form in conjunction with other pamphlets on the fauna of Bombay and Salsette, issued by the Natural History Section of the Prince of Wales Museum.

Mr. C. McCann's paper on the Flamingo, based on observations made during an expedition to the Rann of Cutch is an original and interesting study of the habits of this species. One interesting fact revealed is that the existence of the breeding colony depends upon the brief outburst of a brackish water plant (*Ruppia rostellata*) in the Rann, which is initiated by the flooding of the area by rivers from the mainland, the seeds providing the food for the young. Another interesting discovery is the early deserting of the young by the majority of parent birds; the guardianship of the chicks being left to a few adults who act as 'sentries' and, finally, the march of the chicks across the desert in the wake of the receding water—a tragic retreat in which hundreds perish. Where exactly these chicks go to on leaving the Rann and their subsequent history still remains to be discovered. It would also be interesting to study specimens of these birds at a stage exhibiting the passage from the brown juvenile plumage to the adult white and crimson. The question as to whether the pink plumage is attained by moult or canescence requires further study in the field.

Reptiles and Fishes.

Dr. Hora continued his serial on the Game Fishes of India. Parts VI, VII and VIII were published during the year. Parts VI and VII describe two Fresh Water Sharks—the Goonch

(*Bangarius bangarius*), which has the best title to the name, and the Mulley, *Wallago*—now *Wallagonia attu*. In Part VIII, Dr. Hora deals with the mahseers or large-scaled barbels of India. How many different species now go under the name *Barbus tor*—the Mahseer, we do not know. Dr. Hora's study is an attempt to answer this question and his present paper deals with the mahseer found in the Himalayan Streams—from Kashmir to Darjeeling. To this fish he gives Hamilton's specific name *Barbus putitora*. Subsequent parts will deal with Mahseer from other areas in India and will, it is hoped, provide a clearer idea of true status of the various fishes now generally confused under the name *Barbus tor*.

Mahseer—from the standpoint of their breeding habits—form the subject of a paper by Dr. Hamid Khan. His study of the sex organs of specimens examined by him leads to the conclusion that Mahseer spawn three times a year and that all the eggs in the ovaries are discharged at each spawning season. The author's interesting investigations help to emphasize the need of Dr. Hora's work: since it is not known whether the conclusion relative to breeding habits of Mahseer were drawn from the studies of one or more species.

Another sporting fish which received special attention in the *Journal* during the year is trout. Little attention has been given to the disease of these fish in the various areas in which they have been introduced and established in India. The subject is one of considerable importance to the development of trout fisheries in this country. Dr. Hamid Khan in his paper discusses diseases encountered at the Mahili Hatchery, Punjab, i.e., fin-rot, goitre, inflammation of the intestines, and fungus and gives an account of the remedial measures employed. The diseases of trout were also investigated in the Harwan Hatchery at Kashmir, where a very large number of fish died in 1934. An investigation was then undertaken by the Zoological Survey of India at the instance of this Society. The results of the investigation are published in Mr. Gulam M. Malik's paper in volume xli, No. 2. It is shown that the heavy mortality was due to lipoid or fatty degeneration of the liver, induced by the fatty foods and developed in epidemic form owing to shortage of water, insanitary conditions of the pens and overcrowding. Mr. Malik's paper is supplemented with notes by Brigadier A. Campbell Ross, who contributes an interesting article on Trout Fishing in Kashmir. His recommendations, based on experience of nearly 20 years, merit the serious attention of the Game Preservation Department of the State. Much improvement could be effected if the efforts of the Department were now directed more to the quality of the fish than to the quantity. The author holds that overstocking of the streams and the resulting shortage of food has caused deterioration. A reduction in the numbers of trout is recommended. A second point needing attention, is the enormous stock of other species of fishes present in rivers and streams. While their fry provide food for the trout, the adults themselves reduce the food supply, interfere with the growth of weed and cause unhealthy overcrowding. The need for a reduction in their numbers is stressed. Lastly and

most important of all is the improvement in the natural food supply available to the trout. As most of the rivers are now stocked to capacity it is recommended that a large proportion of the money now spent on trout hatcheries may be devoted with greater advantage to breeding of food supplies. This in our opinion, is a most cogent point, covering as it does the damage done to food supplies by coarse fish, and the necessity of increasing the Trout food supply. Any one with any experience of Trout culture knows that an excess of coarse fish in the water is a serious matter.

The economic aspect of Indian fisheries also forms the subject of two papers by Dr. S. B. Setna on the Marine Fisheries of Bombay. In an article on Bombay's Fishing Industry the author discusses the inadequacy of the supply and the generally neglected condition of the industry, which at the present time is carried out solely by certain impoverished castes and does not attract the educated elements of the population or external capital. The primitive methods employed limit the fishing field to a few miles from the coast: facilities for landing and marketing of fish are poor; while the meagre earnings of the fishermen provide little incentive to enterprise. The Government of Bombay are to be congratulated therefore on the attempt at improving at least one aspect of the Industry by a practical demonstration of the effectiveness of more rapid methods of transport. The work done in Bombay in this respect is the subject of a second article by Dr. Setna which gives the results attained by introducing fast power-propelled launches for bringing in the catches to Bombay. Seven hundred tons of fish over and above the accustomed quantities were brought to the Bombay market in prime condition, and the radius from which the city draws its supplies was increased by 2-3 hundred miles. The success attending this experiment led to a rapid development of power transport and has brought into being quite a fleet of private-owned launches to the benefit of the industry. But increased supplies in Bombay has led to a corresponding decline in the fish available at the fish curing yards and at other coastal ports and no fundamental improvement can be expected until an improvement can be made in the present primitive method of exploitation. If more fish is to be obtained then fishing operations must extend over a wider field, and if the Industry is to develop better then more adequate facilities for the landing, storage and marketing of fishes must be provided. The author discusses measures which should be taken to secure a more general development of the local fisheries which, if followed, should materially benefit an industry of first rate importance to this maritime Province.

Another important section of Indian fisheries was dealt with in Dr. Chopra's paper on Food Prawns and Crabs of India in which the author discusses the various species available in the markets of large towns. The value of the fisheries is not generally realized by the public. The author estimates the yield of the prawn fisheries of India at, at least 3 crores of rupees per annum. Impressive though it may seem, the figure falls into insignificance when compared with other smaller countries where shell fisheries

are conducted on scientific lines. The author discusses the various methods employed in the capture and marketing of Shell fishes.

INSECTS.

During the year we published Parts VI and VII of Mr. Mosely's serial on Indian Caddis Flies which deal with the *Sericostomatidae*. A number of new genera and species are described, and the papers as usual are illustrated with a very large number of fine plates. Mr. D. G. Sevastopulo's notes and observations on the Early Stages of Indian Lepidoptera were issued in three papers during the year.

Butterflies of Burma form the subject of two papers. Capt. W. C. Carrot lists the species taken by him in the Shan States—an interesting area with an abundant and varied butterfly fauna; while in the December number, we published Part I of Notes on New and Interesting Butterflies from Burma by the late Major-General Sir Harry Tytler. General Tytler's long service in many parts of the East gave him opportunity to develop his bent for Natural History. His chief interest lay in Butterflies and he brought together one of the finest collections ever made in India. He published a number of papers on Indian butterflies in the Society's *Journal*. The editing of Part II of Tytler's Notes has been taken over by Mr. G. A. Talbot, F.R.E.S., of the British Museum.

Messrs. C. Cherian and M. S. Kylasam published their studies on the *Laphygma exigua* and its natural enemies. The caterpillars of this moth, which has a world-wide distribution, are well known as pests of crops. In India lucerne, onion, chillies and many other plants suffer from their depredations and the present paper deals with the species in a new role—as a pest of tobacco, and gives the result of investigations conducted to discover suitable predators and parasites which might effectively provide a control over these pests.

BOTANY.

During the year we commenced publication of a serial on Beautiful Indian Climbers and Shrubs under the joint authorship of Dr. N. L. Bor and his colleague Mr. M. B. Raizada of the Forest Research Institute, Dehra Dun. Two parts were issued dealing with *Ipomoea* and *Aristolochia*. Mr. G. Singh's beautiful coloured illustrations are a feature of the work which will be issued as a companion volume to *Beautiful Indian Trees* by Blatter and Millard. The first edition of the latter work published by the Society in 1938 was sold within 8 months. Unfortunately under present war conditions the issue of a second edition would prove too expensive and must be postponed till better times prevail.

Another serial commenced during the year, deals with Common Indian Herbs by Prof. M. Sayeedud-Din of the Osmania University. The serial will describe and illustrate a number of the common species found in India and give supplementary notes on their anatomical characters.

Father Caius continued his interesting serial on Indian Medicinal and Poisonous Plants. Three papers were published dealing with the Crucifers, the Capparids and the Flacourtiads.

In another paper Father Caius publishes the results of his survey of the local trade in Gum Arabic with a view to ascertain the source of the commodity and the uses it is commonly put to.

A contribution of particular interest to botanists is Mr. C. McCann's Additions to the Description of *Frerea indica*, a rare species found only once since its discovery in 1864. The author provides a detailed description of the fruit, seeds and other parts of the plant.

That Nature Photography is steadily increasing in popularity in this country was evidenced by the very large number of excellent pictures shown at the special Wild Life Photographic Exhibition organized by the Society during the year. Camera hunters will find much to interest and stimulate them in the two beautifully illustrated articles written by two of the most successful camera hunters in this country, Major R.S.P. Bates who wrote on 'Bird Photography in India' and Mr. Theodore Hubback who contributed an article on Wild Life Photography in a Malayan Jungle. Both articles contain valuable hints and advice and both are accompanied by fine examples of Camera work.

Forthcoming Publications.—We have been to much trouble to ascertain whether a reprint of the Snake Chart would be welcome. This chart was issued some twenty years ago to hospitals, dispensaries, schools and colleges throughout the country and the reply to enquiries has been so encouraging that the chart is already under weigh, and will appear very shortly. It is already more than paid for. As a companion volume we have decided to issue a fifth edition of Wall's book on the Poisonous Terrestrial Snakes of India, but it will be revised in the light of recent discoveries. The book will, we believe, fill a very real need, and the price will be kept as low as possible.

Common Indian Birds.—Some years ago we published a chart of Common Indian Birds. What we did *not* publish was a commentary on each bird.

We now intend to publish a popular book, showing 200 birds, in colour, with a commentary on each bird by Mr. Sálim Ali.

This book will, we hope, 'Catch 'em Young', and help to inspire an interest in Natural History which, where it exists, has little at present on which to batten.

Revenue Account.—Once again we have managed to balance our budget, and we are able to record a surplus revenue of Rs. 4,466-13-11 as compared with Rs. 3,341-4-9 in 1938.

Total income was Rs. 37,091-9-0 and expenses were Rs. 332,624-11-1; but it must be borne in mind that we have to thank H. E. H. the Nizam, H. H. the Gaekwar of Baroda and H. H. the Maharaja of Patiala for the present state of our finances, as our regular income is not sufficient to cover expenses.

Membership.—67 members resigned during the year and 26 new members were elected, making a total membership of 845 as against 886 at the end of 1938.

Income from publications shows a drop, as the *Tree Book* was sold out fairly early in the year. We have a number of orders booked, and with a little more encouragement a second edition will be undertaken.

Staff.—The Committee wish to record their appreciation of the good work done by the Curator and his staff during the past year.

April 10, 1940.

H. M. McGUSTY
Honorary Secretary.

PRINTED AND PUBLISHED BY V. M. PHILIP AT THE DIOCESAN PRESS, 18 CHURCH ROAD, VEPERY, MADRAS

EDITORS: H. M. McGUSTY, J. F. CAIUS AND S. H. PRATER, 6 APOLLO STREET, FORT, BOMBAY

BOMBAY NATURAL HISTORY SOCIETY.

BALANCE SHEET AS AT 31st DECEMBER 1939.

LIABILITIES	Rs A P	Rs A P
Life Membership fees:		52,675 0 0
Donations for specific purposes unexpended:		
Show Cases, Models of Fish, etc. in Prince of Wales Museum—Account No. 1 ...	336 10 7	
Show Cases, etc., in New Building, in Prince of Wales Museum—Account No. 2.	145 15 11	
Special Journal Fund	2,885 5 4	
Ornithological Survey	2,546 8 0	
		5,914 7 10
Sundry Creditors:		
Brig. W. H. Evans, Account Butterfly Books	118 8 10	
The Diocesan Press, Madras	2,678 10 11	
For Expenses (Audit Fee)	250 0 0	
		3,047 3 9
Donation from H.E.H. Nizam for Expenses:		5,000 0 0
Surplus Assets:		
Balance as per last Balance Sheet ...	27,607 2 0	
Add.—Surplus on Revenue Account ...	4,466 13 11	
		32,073 15 11
Total ...		98,710 11 6

ASSETS	Rs A P	Rs A P
Investments—At holding value or Market value whichever is lower:—		
Rs. 35,000 3½% Loan 1947/50 at 102¼% ...	35,787 8 0	
,, 15,000 5% do. 1945-55 at par ...	15,000 0 0	
,, 10,000 3% do. 1951-54 at 98% ...	9,800 0 0	
,, 14,000 4% Bombay Port Trust Bonds at 77%	10,780 0 0	
,, 15,000 4% Bombay Improvement Trust Bonds at 76%...	11,400 0 0	
,, 5,000 3½% Pro-Note 1854-55 (out of donation received from H. E. H. Nizam)	4,997 4 7	
Rs. 94,000		87,764 12 7
Cash—		
With National Bank of India, Ltd., Bombay, (inclusive of Rs. 2-11-5 out of donation received from H.E.H.Nizam.)	7,479 14 2	
With National Bank of India, Ltd., London, £40-18-8 at 1/6	545 12 5	
On hand	150 0 0	
		8,175 10 7
Sundry Debtors:		639 15 0
Advances to Staff:		105 0 0
Furniture:		
As per last Balance Sheet	1,527 0 0	
Less Depreciation	25 0 0	
		1,502 0 0
Publications excluding Journals: Stock on hand as certified by the Hon. Secretary		150 0 0
Bird Charts and Albums: Stock on hand as certified by the Hon. Secretary		20 0 0
Book on Climbing Shrubs: Stock on hand as certified by the Hon. Secretary		353 5 4
Total ...		98,710 11 6

Note.—A stock of 21,000 old Journals and the valuable research collection and Library of 2,650 volumes have not been taken into account on the asset side of the Balance Sheet.

We have prepared the above Balance Sheet from the Cash Book and from the information given to us, and have verified the Investments.

In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and the explanations given to us.

BOMBAY, 15th March 1940.

Chartered Accountants, Auditors

Honorary Treasurer.

BOMBAY NATURAL HISTORY SOCIETY.

REVENUE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1939.

Dr.

	Rs A P	Rs A P
To Salaries	19,005 0 0	
,, Society's Contribution to Staff Provident Fund	1,480 0 0	
,, General Charges	379 9 5	
,, Rent	2,436 0 0	
,, Stationery and Printing	343 10 8	
,, Postage	908 2 6	
,, Library	313 2 0	
,, Audit Fee	250 0 0	
,, Fire Insurance	199 2 0	
,, Depreciation on Furniture	25 0 0	
,, Cost of Printing Journals	7,285 0 6	
		32,624 11 1
,, Surplus carried to Balance Sheet ...		4,466 13 11
Total ...		37,091 9 0

Cr.

	Rs A P	Rs A P
By Subscriptions	18,253 10 8	
,, Entrance Fees	290 0 0	
,, *Sales of :*		
Old Journals	1,414 7 3	
Game Books, Vols. I, II & III ...	505 12 8	
Society's Publications	287 11 0	
Tree Books	1,518 8 5	
,, Interest on Investments and Fixed Deposits	3,279 5 0	
,, Profit on outside works	1,542 2 0	
,, Donations from Vice Patrons available for current expenditure	10,000 0 0	
		37,091 9 0
Total ...		37,091 9 0

PUBLICATION ACCOUNT FOR THE YEAR ENDED 31st DECEMBER 1939.

Dr.

	Rs A P	Rs A P
To Expenses during the year on Bird Chart and Albums		660 0 0
,, Book on Climbing Shrubs		353 5 4

Cr.

	Rs A P	Rs A P
By Sales of Bird Charts and Albums ...	640 0 0	
,, Stock on hand (31st December, 1939) ...	20 0 0	
		660 0 0
,, Stock on hand (31st December, 1939) ...		353 5 4

Dr. **Cr.**

INCOME AND EXPENDITURE ACCOUNT OF DONATIONS FOR SPECIFIC PURPOSES FOR THE YEAR ENDED 31st DECEMBER, 1939.

	Rs A P	Rs A P		Rs A P	Rs A P
Fund No. 1					
To Expenditure on Fish Gallery, etc. ...	760 0 0		By Unexpended Balance as per last Balance Sheet		
,, Balance carried to Balance Sheet ...	336 10 7	1,096 10 7			1,096 10 7
Show Cases Fund No. 2					
,, Balance carried to Balance Sheet ...		145 15 11	,, Unexpended Balance for Show Cases in New Building as per last Balance Sheet		145 15 11
Special Journal Fund					
,, Expenditure on Journals	4,132 11 0		,, Unexpended balance (Special Journal Fund) as per last Balance Sheet ...	6,314 11 0	
,, Balance carried to Balance Sheet ...	2,885 5 4	7,018 0 4	,, Donations received during the year ...	703 5 4	7,018 0 4
Ornithological Survey					
,, Expenditure on Ornithological Survey ...	4,953 8 0		,, By Unexpended balance as per last Balance Sheet	2,000 0 0	
, Balance carried to Balance Sheet ...	2,546 8 0	7,500 0 0	,, Donations received during the year ...	5,500 0 0	7,500 0 0

BOMBAY, *15th March, 1940.*

Examined and found correct.
(Sd.) A. F. FERGUSON & CO.
Chartered Accountants, Auditors.

(Sd.) H. M. McGUSTY,
Honorary Treasurer.

Vol. XLII, No. 2. APRIL, 1941. *Price, Rs. 10 net.*

THE

JOURNAL

OF THE

Bombay Natural History Society.

EDITED BY
REV. J. F. CAIUS, S.J., F.L.S., H. M. McGUSTY,
AND S. H. PRATER, M.L.A., C.M.Z.S.

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The terms are the same for members living outside India. Such members should pay their subscriptions by means of orders on their Bankers to pay the amount of the subscription, plus postage—in all Rs. 26-8-0—to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £2-0-6 should be paid annually to the Society's London Bankers—The National Bank of India, Bishopsgate Street, London, E.C.

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MUSSÆNDA FRONDOSA Linn.
Paperchase Tree or Dhoby's Tree (Nat. Size)
93·4 per cent.

740

JOURNAL
OF THE
Bombay Natural History Society.

1941. VOL. XLII. NO. 2.

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS.

BY

N. L. BOR, M.A., D.SC., F.L.S., I.F.S.,

Forest Botanist,

AND

M. B. RAIZADA, M.SC.,

Assistant Botanist,
Forest Research Institute, Dehra Dun.

PART VI.

(*Continued from Vol.* xlii, *No.* 1 (1940), p. 12).

(*With* 1 *coloured and* 3 *black and white plates, and* 3 *text-figures*).

Rubiaceae

A very large family of over 4,500 species, comprising herbs, shrubs, climbers, and large trees. A small number are epiphytes. Many beautiful shrubs belonging to this family are cultivated in our Indian gardens for their handsome, occasionally fragrant, flowers.

The leaves are opposite or whorled, stipulate, usually entire, with pinnate nervation. The stipules are interpetiolar, that is, the two adjacent stipules are joined together across the node, forming a half sheath, simple or divided into lobes or fringed. The flowers are variously arranged, sometimes in globular heads, sometimes in corymbose cymes or panicles, axillary or terminal. Calyx often campanulate, adnate to the ovary, truncate or with 5 lobes. Corolla gamopetalous, seated on the top of the ovary, more or less tubular with spreading lobes; lobes 4-10, imbricate or valvate. Stamens as many as the lobes seated on the corolla and alternate with the lobes. Disk present, annular or lobed; lobes as many as the ovary cells. Ovary inferior, 2- or more-celled with axile, basal or apical placentation. Ovules one to many. Fruit a capsule, berry or drupe.

The family takes its name from *Rubia cordifolia,* a well-known Himalayan plant, which used to be the source of madder before the days of synthetic dyes. It is still largely used by the hill tribes to dye thread.

Apart from plants of ornamental value there are many species of *Rubiaceae* which are of economic importance. Quinine, so widely used in malarial cases, is a product of *Cinchona ledgeriana* and other species of *Cinchona,* which are indigenous in South America.

The drug, quinine, is of such importance in all tropical malarial countries that it will be of interest to retail briefly in narrative the history of this plant and its introduction into India. A great deal of the information contained in this account has been obtained from *Travels in Peru and India* by C. R. Markham (afterwards Sir Clements Markham), who had a great deal to do with the introduction of this genus of plants into India. His book may be recommended as a first class travel book, full of curious information apart from its worth as botanical history.

The genus *Cinchona* was erected by Linnaeus in honour of the Countess of Chinchon, of whom more later. As there has been some dispute regarding the correct spelling of this name, it will perhaps be better to settle the matter at once. Some hold that the spelling should be *Chinchona,* on the grounds that *Cinchona* implies a mark of disrespect to the Counts of Chinchon, the hereditary Alcaides of the Alcazar of Segovia.

A reference to the Species Plantarum of Linnaeus, Vol. I, page 172, shows that the famous Swede spelled the name *Cinchona,* a spelling which, following the rules of International Botanical Nomenclature, must stand. Linnaeus mentions one species, *Cinchona officinalis*, and in addition informs us that it is also called Quinquina and 'habitat in Loxa Peruviae'.

The name 'quinquina' is the Peruvian name for the tree and means 'bark of bark', a circumstance that Markham uses to refute the idea prevalent at the time that the Peruvians had no knowledge of the febrifugal properties of what afterwards came to be known in the trade as Peruvian bark. The reasons of this belief were that this bark was not found in the wallets of the Peruvian doctors nor did they communicate their knowledge of its virtues to their conquerors. This, however, can be easily explained by their hatred for the Spanish invader.

Whether the inhabitants of Peru knew of the febrifugal properties of the bark of quinquina or not, it is certain that the Spaniards must have known of them before 1638. In that year the wife of Luis Geronimo Fernandez de Cabrera Bobadilla y Mendoza, fourth Count of Chinchon, lay ill of intermittent fevers in the palace at Lima in Peru. 'The Corregidor of Loxa, Don Lopez de Canizares, on hearing of her illness, sent a parcel of powdered quinquina to her physician, Juan de Vega, who was also captain of the armoury, assuring him that it was a sovereign and never-failing remedy for tertiaria' (Markham). The gallant captain fortunately was able, despite his duties at the armoury, to administer the drug to the Countess, and the result was a

complete cure. As we have already seen Linnaeus immortalized the lady by calling the genus *Cinchona* after her, doubtless influenced by the extraordinary belief of those days that a person of rank conferred an honour upon a drug by kindly consenting to be cured by it. The lords of Chinchon are, however, said to have made history in another direction by giving Charles I of England in 1623 a supper of 'certaine trouts of extraordinary greatnesse'.

Following the cure of this important personage the Jesuits were entirely responsible for the introduction of Peruvian bark into Europe. In 1670 it appears to have been largely used with success in Rome to cure fevers of all kinds. Apparently it was at that time known as 'Jesuits' bark' and as such was naturally avoided by all good Protestants. Gradually, however, prejudice was overcome and by 1726 the bark was held in high repute in all European countries as a cure for various fevers.

The popularity of Peruvian bark naturally led to the destruction of hundreds of thousands of trees to provide for the European trade so that in time the trees were threatened with extinction.

The Dutch apparently were the first to take steps to introduce the tree into their colonies and *Cinchona* plants were landed in Java in 1854. Sir Clements Markham led an expedition from England to the Andes in 1855, and the seeds and plants of *Cinchona* obtained by him and his assistants reached Kew in 1860; and the same year Markham landed in Bombay with 125 seedlings. These were planted in the Nilgiris but all died. Others, however, arrived from Kew and extraordinary progress was made, so that by 1862 there were something like 30,000 plants established. From these beginnings the cultivation of *Cinchona* spread all over India and has reached enormous proportions. In 1937-38 the total amount of quinine products sold in Bengal was in the neighbourhood of 30,000 lbs.

Ipecacuanha, which contains among other alkaloids the valuable emetine, largely used as a specific in cases of amoebic dysentery, is obtained from *Cephaelis* (*Psychotria*) *ipecacuanha* Rich. This plant has not had nearly so important a career as the noble *Cinchona,* as it only came to light through the travels of a Portuguese priest, Manoel Tristaon, in Brazil during the sixteenth century. The properties of the drug became known in Europe during the 17th century. The plant was introduced into India in 1866.

In addition to *Rubia cordifolia,* mentioned above, another genus *Morinda,* is well-known as a source of fast dyes. The colours obtained from it range from yellow to red, purple and chocolate.

Coffee is obtained from *Coffea arabica* Linn., an African plant, now largely cultivated in South India. The well-known tanning material, called Gambier in the trade, is furnished by the climber, *Uncaria gambir* Roxb.

The climbing genus *Uncaria* (from *uncus,* a hook) climbs by means of axillary hook-shaped tendrils. *Paederia foetida,* a common jungle plant in India, is a twiner.

Little is known of the mechanism of pollination of the species of this large family. In *Ixora* the anthers are pressed against the style in the bud. Before the flower bud opens the anthers dehisce and large quantities of pollen are left adhering to the tip of the 2-lobed style. The stigmatic surfaces of the stylar lobes are pressed together at this time and effectively prevent self-fertilisation. The unexpanded style is supposed to act as a perching rod for insects which carry away the pollen to older flowers. Subsequently the stigmatic lobes become recurved and expose the receptive surfaces to a visitor carrying pollen from another flower. This genus which has very highly coloured flowers would appear to favour cross fertilisation.

Key to the Genera.

Shrubs without thorns.
  Flowers with one calyx lobe expanded into a white leaf-like structure; flowers orange or pale yellow ... ... 1. *Mussaenda*.
  Flowers with calyx lobes not so expanded.
    Plant foetid when bruised, leaves small. ... 2. *Serissa*.
    Plant not foetid when bruised.
      Flowers white.
        Flowers fragrant ... ... 3. *Gardenia*.
        Flowers not fragrant ... ... 4. *Coffea*.
      Flowers coloured.
        Flowers red, yellow or orange.
          Corolla salver-shaped.
            Corolla lobes pointed ... ... 5. *Ixora*.
            Corolla lobes rounded ... 6. *Rondeletia*.
          Corolla tubular ... ... 7. *Hamelia*.
        Flowers mauve or white ... ... 8. *Hamiltonia*.
Thorny shrub with greenish flowers ... ... 9. *Catesbaea*.

Part I.

1. **Mussaenda** Linn.

(*mussaenda* is the Sinhalese name for the species of this genus).

Shrubs or undershrubs, sometimes scandent, with opposite or ternately whorled leaves. Stipules free or joined together, persistent or deciduous. Flowers usually yellow in terminal cymes. Calyx oblong, top-shaped or globose, with 5 lobes, one of which is expanded in a large white or coloured leaf. Corolla tubular below, funnel-shaped above; throat villous; lobes five, valvate in the bud, with everted margins, spreading in the open flower. Stamens in the tube or throat; filaments very short; anthers linear. Ovary 2-celled; ovules many on peltate fleshy placentae. Fruit a berry. Seeds many, pitted.

Key to the species of Mussaenda.

Flowers pale yellow ... ... *M. luteola*.
Flowers orange red ... ... *M. frondosa*.

Photo by *M. N. Baks*

Mussaenda luteola Del.
New Forest, Dehra Dun.

Mussaenda luteola Del.

(*luteolus* means yellowish in Latin, and refers to the colour of the foliaceous sepal of this species).

Fig. 1.—*Mussaenda luteola* Del. × 1/1.

Description.—A small, erect, twiggy slender shrub. Branches green, somewhat compressed, covered with a hoary, appressed pubescence. Leaves 1.5-2 in. long, petiolate, elliptic-lanceolate or oblong-lanceolate in shape, acuminate at the tip, narrowed at the base, membranous, olive-green above, pale below, sparsely hairy above, covered on the nerves below with short appressed pubescence; petiole short. Stipules subulate.

Inflorescence of few flowered corymbs. Calyx tube 5-angled, .1 in. long, shortly hairy, 5-lobed; lobes subulate .2 in. long except one which is often produced and expanded into an elliptic-acuminate or ovate foliar structure, .75-1 in. long, yellowish in colour, seated on a 'petiole' .4 in. long. Corolla tube 1 in. long, densely velvety pubescent at the mouth, greenish, pubescent, swollen about 1/3 the way down at the insertion of the stamens, 5-lobed; lobes pale

yellow in colour, broadly ovate, long acuminate. Stamens 5, sessile; anthers linear, included. Ovary 2-celled; ovules numerous. Style slender, glabrous, divided at the top into two stigmatic lobes.

Flowers.—Hot and rainy season. *Fruits.*—This shrub seldom fruits in Dehra.

Distribution.—Native of tropical Africa, but now commonly cultivated in gardens throughout the plains of India.

Gardening.—A pretty bushy shrub with dense dull-green foliage and pale yellow foliaceous sepal. Propagated usually by layers, as cuttings are less successful. According to J. D. Hooker it was first introduced into Europe about 1860 by Capt. Grant from the head-waters of the Nile.

Mussaenda frondosa Linn.

Paperchase Tree or Dhoby's Tree.

(*frondosa* is a Latin word meaning leafy).

Description.—An erect shrub. Branches green, angled when young, covered with a coarse brown pubescence. Leaves opposite, shortly and stoutly petioled, ovate or elliptic in shape, obtusely acute or acuminate at the tip, narrowed or rounded at the base, membranous, glabrous or sparsely hairy above, softly hairy on the lower surface, 6-9 in. long, by 3-4 in. wide; petiole stout, .5 in. long, coarsely hairy. Stipules large, broadly ovate-obtuse, often splitting at the apex into two lobes, covered with longish hairs.

Inflorescence in terminal cymes supported by two reduced leaves. Peduncles stout, very hairy; bracts and bracteoles present. Individual flowers subsessile. Calyx tube .2 in. long, adnate to the ovary, glabrous or sparsely hairy, oblong in shape, 5-lobed; lobes linear or subulate, .4 in. long, ciliate with long hairs. One lobe is occasionally produced into a hairy petiole, .75 in. long, to which is attached a leaf-like, white, elliptic-lanceolate appendage, 1 in. long or more. Corolla tube cylindrical, slender below, widened above the position of the stamens, covered with silky hairs, pale green in colour, yellowish hairy at the mouth, 5-lobed; lobes thick, fleshy, ovate-acute, yellowish green outside, inside of a beautiful orange-red colour, covered with a minute golden glandular excretion. Stamens 5, linear, sessile, included within the glandular hairy tube about half way down; the filaments are slightly adnate to the tube for the whole of their length, making the anthers sessile, but they can be easily separated. Ovary 2-celled; ovules numerous. Style short; stigmas 2.

Flowers.—Hot and rainy season. *Fruits* at the end of the rains.

Distribution.—Indigenous in Assam, Upper Burma, South India and Ceylon.

Gardening.—This is one of the commonest shrubs to be found in Indian gardens. The white foliaceous sepal in contrast to the deep green colour of the foliage makes it an ornamental and conspicuous shrub. It is advisable to prune it in the cold weather when it is

Photo by M. N. Bakshi

Mussaenda frondosa, Linn.
New Forest, Dehra Dun.

Photo by M. N. Bakshi

Mussaenda frondosa, Linn.

deciduous. It is popularly known as the 'Paperchase' tree or Dhoby's tree on account of the fancied resemblance of the white foliaceous leaf to handkerchiefs or bits of paper. Easily raised by cuttings.

2. **Serissa** Comm.

(Bailey[1] remarks that the generic name comes from the Indian name of this plant. On the other hand, Roxburgh says that this plant was introduced from China and hence there is no Indian name for it).

A branchy shrub. Leaves opposite, subsessile, subcoriaceous, ovate-acute, foetid when bruised. Stipules cuspidate, interpetiolar, persistent. Inflorescence of solitary or fascicled flowers, axillary or terminal, sessile. Hypanthium obconic, ending in 4-6 lobes which are subulate-lanceolate in shape, persistent. Corolla infundibuliform, hairy outside and in the throat; lobes 4-6, short, induplicate-valvate in the bud. Stamens 4-6, inserted at the base of the tube; filaments very slender; anthers linear-oblong, included. Ovary 2-celled; ovules 1 to each cell, basal. Style slender, ending in two subulate stigmatic lobes. Fruit fleshy, containing two seeds.

Serissa foetida Lamk.

(*foetidus* means evil smelling in Latin, and refers to the unpleasant odour of the leaves and flowers when bruised).

Fig. 2.—*Serissa foetida* Lamk. × 1/1.

Description.—A shrub with many glabrous branches. Young branches quadrangular, brown, covered with sparse hairs, becoming round, greyish in colour, and glabrous. Leaves small, .3-.75 in.

[1] The Standard Cyclopedia of Horticulture.

long by .2 in. wide, oblong or oblong-lanceolate in shape, acute at both ends, olive-green above, paler beneath, coriaceous in texture; nerves 3-4 main pairs, ascending obliquely, prominent below, hardly visible on the upper surface; petiole .05 in. long. Stipules interpetiolar, sheathing at the base, divided above into several setaceous lobes.

Inflorescence of terminal fascicles of flowers, with an involucre of leaves. Flowers seated on very short pedicels; bracteoles broad and membranous at the base, connate into a sheath surrounding the flower, ending above in 2 long sharp, setaceous, ciliate lobes. Calyx tube very short, 4-5-(rarely 6-8-) lobed; lobes .1 in. long, lanceolate-acute, with ciliate margins. Corolla tube .2 in. long, cylindrical at the base, funnel-shaped above, hairy within; lobes 4-5, less than .1 in. long, ovate-obtuse. Stamens 5, inserted in the lower third of the tube or above; filaments short; anthers linear-acute, about .1 in. long, included or slightly emergent. Ovary 2-celled; ovules 1 in each cell, basal; style slender ending in 2 stigmatic lobes. Fruit a berry with 2 seeds.

Flowers.—Practically all the year round.

Distribution.—Indigenous to China and Japan. It has long been cultivated in gardens in India.

Gardening.—A small shrub about 2 ft. high. It is nearly always in bloom with its sparkling rather small white flowers which, like the leaves, when bruised emit a foetid stench. Single- and double-flowered forms are both quite common in gardens. According to Aiton's Hortus Kewensis' it was introduced into England in 1787. Propagated by cuttings.

Medicinal uses.—The stem and leaves are said to be used by the Chinese for the treatment of carbuncles and cancer.

3. **Gardenia** Linn.

(A genus erected by Linnaeus in honour of Dr. Alexander Garden of Charleston S.C., one of his correspondents).

Trees or shrubs, thorny or not. Leaves opposite, rarely ternate; stipules connate or not. Flowers solitary, fascicled or collected into cymes, usually large. Calyx lobes usually long, persistent in fruit. Corolla tube cylindrical or campanulate, 5-12-lobed; lobes twisted in the bud. Stamens as numerous as the lobes of the corolla and alternate with them; anthers linear, inserted on the tube, included, sessile or subsessile. Ovary 1-celled; ovules in two series on parietal placentae. Fruit fleshy with a leathery epicarp.

Gardenia florida florida Linn. (*G. jasminoides* Ellis).

Cape Jasmine.

(*florida* is a Latin word meaning many-flowered).

Description.—A shrub reaching 6 ft. in height. Young branches brown, becoming covered with a greyish bark, striate. Leaves opposite or ternate, oblong-elliptic or obovate-lanceolate in shape, obtusely acuminate, wedge-shaped and decurrent at the base, shining, 3-6 in. long by .5-2 in. wide. Stipules about .5 in. long, acute, membranous.

Inflorescence of terminal solitary, white, very fragrant flowers, seated on 6-winged pedicels, .3 in. long. Calyx tube .3 in. long, bearing 6 longitudinal wings, 6-lobed; lobes up to .75 in. long, oblong, acute, persistent. Corolla tube 1.75 in. long, glabrous inside and out, 6-lobed; lobes up to 1 in. long, obovate, obtuse or

Fig. 3.—*Gardenia florida* Linn. × 1/1.

rounded at the top, narrowed at the base, fleshy. Stamens 6, long exserted; filaments short; anthers .6 in. long, linear-obtuse. Ovary incompletely 2-celled; ovules very numerous on 2 placentas. Fruit 1-1.75 in. long, .5-.75 in. wide, ovoid or elliptic, surmounted by the calyx-lobes, winged on 6 ridges.

Flowers.—March-April. *Fruits.*—Cold season.

Distribution.—Native of China, now widely cultivated in gardens throughout India.

Gardening.—A pretty shrub with handsome, dark green, glossy foliage. It produces at the beginning of the hot season numerous, double, creamy-white, strongly and sweetly scented flowers which resemble those of a double Camellia. It usually grows to about 6 ft. or so but may be kept to any convenient size by pruning. Easily propagated by cuttings during the rains. It is suitable for hedges and cut flowers.

Medicinal and economic uses.—The pulp of the fruit gives a yellow dye. A decoction of the leaves and roots with or without sugar, is used to alleviate fevers.

SOME ORNITHOLOGICAL RESULTS OF THE VERNAY-CUTTING EXPEDITION OF 1938/39 TO NORTHERN BURMA.

BY

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(With two plates).

It has been suggested that I should write a brief account for readers of the *Journal* of the expedition which Mr. Arthur S. Vernay and Mr. Suydam Cutting of New York led to the Laukkaung subdivision of the Myitkyina district in the cold weather of 1938/1939. A full account from the ornithological standpoint of this expedition, the other members of which were Captain Kingdon Ward, F.R.G.S. and Dr. Harold Anthony, Mammal Curator of the American Museum of Natural History is appearing in the pages of the *Ibis*. We were most ably assisted by four skinners under Mr. Joseph Gabriel, whose services were lent to us by the authorities of the Prince of Wales Museum, Bombay. We also received invaluable local assistance from Mr. R. E. McGuire, I.C.S., and the Assistant Superintendent at Laukkaung, Mr. J. W. McGuinness, Burma Frontier Service and many of their subordinates, as we did from the Rev. L. R. Dudrow and numerous officers of the Burma Frontier Force.

Captain Kingdon Ward and I left Myitkyina on November 16 and marched 11 stages to Htawgaw with 80 mule-loads of stores and equipment. From there he went on to Gangfang (5,000 feet) on the upper reaches of the Ngawchang stream to establish a base camp while I returned to Myitkyina to meet the other members of the party. This preliminary trip, made in perfect weather just after the conclusion of the rains, was a very fortunate one, as on it without moving from the mule-path and within the space of a few days we obtained a number of very rare birds including four specimens of *Harpactes wardi*, (the dark Trogon which had been once previously obtained by K. W. in the Seinghku Wang in the far north of Burma,) *Emberiza tristrami*, a small dark bunting which was new to the avifauna of India, *Pteruthius rufiventer*, and a specimen of the rare sandlark of Tibet, *Alaudula rufescens;* a number of hill-birds were found at remarkably low altitudes in the N'Mai Valley, and the steep Pyepat ridge above Laukkaung which had yielded several rare birds to me in previous briefer trips over it, produced a series of the little Green Tit Babbler (*Pseudominla cinerea*) and two rare finches, *Procarduelis nipalensis* and *Propyrrhula subhimachala*. In addition to this, I obtained an avocet on a village pond near Myitkyina, and a series of twelve dusky

thrushes (*T. obscurus*) which were apparently migrating. I am no botanist and have no hope of attempting to describe to readers of the *Journal* the very numerous botanical discoveries made by Captain Kingdon Ward, but I cannot forget his excitement at finding a new Cypripedium on the Pyepat ridge which had only once previously been found 600 miles further south in the Dawnas of Tenasserim. Throughout the journey, his great experience of travel, his eye for fruiting trees, and, beyond all, his painstaking work on the 'stomach-contents' of birds were of the highest value to me.

On December 12 Messrs. Vernay, Cutting and Anthony arrived at Myitkyina and we set off next day for Laukkaung where a week later we met the advance party who had returned from Gangfang. We secured some notable birds on the second journey including a scarlet finch (*H. sipahi*) and a specimen of the rare white-headed black bulbul, a shy and elusive bird which I had pursued unsuccessfully in these hills for 3 or 4 years. I was also lucky enough to secure four martins (*D. cashmiriensis*) of which one or two large flocks seemed to haunt the hillside near Laukkaung. I shall, however, always regret losing a large fruit-eating bat, as big as a woodcock, which gave me two easy chances at dusk near Tamu on the N'Mai:

'What is hit is history
and what is missed is mystery.'

This adage, alas! was too often in my mind all along; the owls, in particular, and the raptorial birds eluded us more or less throughout the trip.

We stayed for Christmas at Htawgaw and here several more rare birds were obtained. I shot a black finch (*Pyrrhoplectes epauletta*) and some Tibetan siskins, and also obtained a fine series of black bulbuls in two colour-phases. These, like most other birds in Htawgaw, were coming in in large numbers to flowering *leucospectrum* (dead nettle) and the dark grey birds obtained were all females and the black birds males.

We then moved on to Gangfang but halted for three days on the way to photograph an immense and picturesque gathering of Kachins, Chinghpaws, Marus, Lashis and Lisus which had come in to Gamhkawn for a feast and a congress organised by the Baptist Kachin Mission. Here numerous laughing-thrushes were seen on dead nettle and two of the rare striated laughing-thrushes were obtained. We reached Gangfang, our base-camp at the junction of the Ngawchang and Hpawte streams, on January 1, Dr. Anthony obtaining a specimen of *Emberiza cia* along the path.

While at Gangfang fresh takin-droppings were brought in from the hills behind Vijawlaw and a party consisting of Messrs. Vernay, Cutting and Kingdon Ward went after them without success, though a specimen of the rare *Myzornis pyrrhoura* was obtained. The writer camped alone on a stream above Hpawshi and spent three days after a bear in magnificent but very steep oak forest at the head of this stream. A fine male black bear was eventually obtained, and a skinner also shot, close to camp, a specimen of the

rare shortwing (*Brachypteryx stellatus*). This forest seemed however curiously empty and bird life, apart from a few hill partridges, very scarce, though the Lashis sometimes contrived to call up a number of small birds by uttering the four-fold note of the spotted owlet on a bamboo pipe. This note is used by both Lashi and Lisus throughout these hills. I never got above 9,500 feet on this trip but a pheasant which I believe to have been a *monàl* was heard and the villagers here had many traps out for tragopan on cleared ground under the oak-trees. While we were at Gangfang, a Lisu brought in from Vijawlaw a live specimen of the slender-billed scimitar babbler (*Xiphiramphus superciliaris*), new to the Burma avifauna and the only one we saw throughout the trip.

On January 14 we started for Imaw Bum, with a long train of coolies in heavy rain which powdered the hills around with snow as low as 7,000 feet. On the second day we camped at 8,000 feet in moss-covered oak forest in which we saw many of the dark *Leioptila pulchella,* the Nepal cutia (*Cutia nipalensis*), and a flock of Blyth's suthora (*Suthora poliotis*).

On the following morning we crossed the Nyetmaw Pass (10,200 feet) into the Imaw basin, three blood pheasants (*Ithaginis c. kuseri*) being obtained on the way and a specimen of the rare yellow-browed tit (*Sylviparus modestus*) which was found, later, to be not uncommon in this forest.

North of the pass we came at once into heavy snow and the temperatures at 9,500 feet for the next week were extremely low. Bird life was scarce but the few birds met with made up in rarity what they lacked in numbers; the environs of one small alpine meadow, about an acre in extent, in which stood a few crab apple trees, produced the following: the allied grosbeak, the brown suthora, the great parrotbill (*Conostoma aemodium*) the dark rose-finch, (*Carpodacus edwardsii*), the black-faced laughing thrush, the Nepal tree creeper (*Certhia himalayana*) and the yellow-billed magpie (*Urocissa fl. flavirostris*). We also obtained at about 10,500 feet a specimen of the white-throated redstart (*Phoenicurus schisticeps*) and one of a flock of the little *Suthora fulvifrons,* a parrotbill of the high bamboo. Captain Kingdon Ward also shot a white-bellied dipper on the snow and icebound stream which flanks Imaw Bum and saw a Himalayan Kingfisher. A pair of very wild dippers seen by me on the same stream were, I think, the brown dipper (*Cinclus cinclus*).

The snow stopped us above 10,500 feet and we did not attempt the ascent of Imaw Bum. We saw no large mammals, though a few tracks (those possibly of the small panda and also of some ungulate) were seen in the snow.

A forest-fire, deliberately lit by Chinese traders, greatly disturbed the eastern face of this valley while we were here.

On January 26, the expedition divided; Messrs. Vernay, Cutting and Kingdon Ward crossed the northern edge of the Imaw ridge at 11,000 feet to Luktang and so down to the Ngawchang and round again to Htawgaw. They were, for the greater part of this trip, collecting at altitudes below 4,000 feet but met with several rare birds including the first Burmese specimen of the

Imaw Bum from near the Chimili. Typical Tragopan country.

An unknown valley near Imaw Bum.

Takin country at 12,000′ near Chimili Pass.

View up the Hpawte Valley towards Chimili Pass.

Himalayan crossbill (*Loxia curvirostra*). Dr. Anthony and myself recrossed the Nyetmaw Pass and spent a week in the forest south of it at 8,700 feet; the feature of this camp were the huge, grotesquely writhen, trees of *Rhododendron magnificum*, whose mossy trunks attracted many birds and whose huge leaves, two and a half feet long, provided shelters for our coolies. Birds on the south side of the pass were much more numerous and among them we met almost daily tits of three species, including Chinese black-headed tit (*Aegithaliscus bonvaloti*), many hoary barwings (*Ixops nipalensis*), *Herpornis xantholeuca* and vast numbers of stripe-throated yuhinas (*Yuhina gularis*). Other birds which had hitherto been accounted extremely rare in this part of Burma were the golden-breasted fulvetta (*Lioparus chrysotis*), the little chestnut-throated shrike-babbler (*Pteruthius melanotis*) and the nutcracker. The bulk of the birds here were feeding on *aralia* berries, the trees of which were in great abundance. On the last two days a pair of the beautiful white-spotted laughing thrush (*Garrulax ocellatus*) were shot in bamboo and a Trogon at 8,500 feet which turned out to be a new high altitude form of the red-headed trogon (*Harpactes erythrocephalus*).

Once again as we found throughout the trip, bird life above 9,000 feet was extremely scarce even in quite undisturbed forest land. At about 10,000 feet we saw tracks which were either of serow or gooral, and very numerous mouse-hare holes: pig undoubtedly occurred as high as our camp, and the only mouse-hare met with was trapped at that altitude. Dr. Anthony 'hi-jacked' at night with a lamp but the only mammal obtained in this way was a fine specimen of the large flying-squirrel.

We returned to the base camp on January 31, and two days later set off for the Chimili Pass. At Gangfang I obtained a solitary Ibisbill which had been seen on the river in January. We spent one night at Hpawte, a big Lisu village standing on a bare rock-strewn hillside and here, among the hundreds of little buntings which thronged the grass and bracken, I managed to secure a specimen of the rare rufous-breasted hedge-sparrow (*Prunella strophiata*), a dark and very wary bird which was not uncommon in bracken and rocks elsewhere, and also two or three of the equally rare Manipur Fulvetta. This latter is found at much lower altitudes than Oustalet's Fulvetta which is the common bird of the cane above 10,000 feet.

We camped next night at 10,500 feet about two hours march from the Chimili Pass. As elsewhere at such an altitude it was possible to be out for many hours between 10,000 and 12,000 feet and think oneself lucky to see one bird, but we found the avifauna of the Chimili hills very similar to that of the Imaw hills forty miles away. All the three rare parrotbills, (*Conostoma aemodium*, *S. unicolor* and *fulvifrons*) were obtained at between 11,000 and 12,000 feet, and a flock of tits passed daily within a few yards of camp. These tits included *Parus ater*, *rufonuchalis* and *dichrous*, also *Aegithaliscus bonvaloti*. We also obtained three of the little-known shrike-babbler (*Pteruthius xanthochloris*). A yellow-browed tit (*Sylviparus modestus*) was seen in a pine tree with a flock of

Parus at about 11,500 feet. The common bird of the cane and the upper limit of the tree was the beautiful little Oustalet's fulvetta (*F. vinipectus*). I saw no pheasants but a pair of Temminck's tragopans were brought in by a Lashi and on the last morning I again heard the strange loud cry which I took to be that of a *monàl*. Every morning at dawn we used to hear the forlorn note of the spotted owlet, and a pair of jungle crows were frequently seen near camp. A pair of black eagles flew one evening along the ridge at 12,000 feet and quartered over the great cliff which flanks the Hpawte stream headwaters. I also saw a buzzard at this altitude. The larger mammals were again very scarce here though snow stopped us exploring the 2 big valleys north and south of the pass-road where takin undoubtedly occur.

It snowed very heavily on our last three days in this camp but we were surprised to find that life in a single-fly tent warmed with a hurricane lamp was not intolerable at that altitude. The skinners however suffered severely and also our cook, a Mugh from Chittagong, into whose philosophy no dream of snow had ever entered.

After a week here we were recalled to Gangfang to meet the rest of the expedition. A fine red serow, shot by Lisus in the snow behind Vijawlaw, was brought into camp at Hpawte on the journey back.

On our return to Gangfang, it was decided to abandon our original proposal to visit the Sajyang Pass and the high hills at the headwaters of the Ngawchang stream. New birds were secured daily which included a solitary snipe and Elwes's crake on a tiny pond close to the base-camp. Teal were seen apparently on migration and large flocks of Tibetan Siskins and Nepal House Martins.

We then spent a few days at 7,500 feet in the abandoned cantonment of Hpimaw. Spring was now upon us and the Hpimaw pass road was almost blocked with several feet of snow. Birds obtained at this camp included a fine series of bull-finches (*P. erythaca*), the black woodpecker (of the very large form *forresti*) and a dusky thrush (*Turdus n. eunomus*). I spent much time on the pass-road with indifferent success but saw here a pair of jays and a pair of allied grosbeaks (*Perissospiza icteroides*). I subsequently saw jays at between 8,000 and 10,000 feet in two other places but they eluded me throughout the trip. They were probably Rippon's jay which Lord Cranbrook obtained in the Adung. I also saw close to me at 9,000 feet an immense wild-boar and hoolocks were heard at about this altitude on the day we left.

One rare bird which escaped me here was *Emberiza elegans*, a dark bunting with a conspicuous yellow head. A Lisu had brought in one to us at Gangfang, and I had a good view with glasses of another at Hpimaw, but it was nearly a month later when I managed to shoot two at Htawgaw which I had seen four or five times. As this bird was observed or obtained at four widely-separated camps it cannot be uncommon in these hills but it is quite new to the Indian avifauna.

We then returned to Htawgaw and marched southwards to a

camp near the Panwa Pass. At Hparè a fine male Lady Amherst pheasant (*Chrysolophus amherstiae*) was brought in by villagers and Dr. Anthony also saw a wolf, unfortunately just too far to shoot. Wolves undoubtedly occur in small numbers in Yunnan and the villagers in the neighbourhood of the Hparè and Panwa passes say they come over at infrequent intervals. There is a record of two being shot near the Spimaw Pass by sepoys after the Four Years War. The country now became much more open and our camp at Changyinhku was on the edge of scattered oak and alder forest, with great patches of scarlet flowering *Rhododendron delavayi.* This forest was full of birds we had not met with before, and on the alder cones we obtained Himalayan crossbills and Tibetan siskins while the oak forest held woodpeckers of four or five species, tree creepers, the small minivet and nuthatches. At one patch of flowering rhododendron the birds seen searching for the nectar included jungle crows, red-billed magpies, Chinese barbets, yuhinas of two species, rose-finches and the little scarlet Dabry's sunbird, also two forms of pied wood-pecker and cinnamon sparrows. Under the oaks we got *Emberiza cia,* and others on the open meadows near the pass, and saw many Stone's pheasants (*Phasianus elegans*). This pheasant, in all its notes and ways most closely resembling the pheasants of home, was the only one we had any opportunity to observe or shoot throughout the trip. The bare round hills of Changyinhku, where there were occasional patches of potato cultivation, also held many skylarks (*Alauda arvensis*). These were mostly in pairs and the males were singing as were stonechats, and white wagtails. I have little doubt all three nest there.

Close to the pass I obtained three woodcocks, two of which were feeding at a stream in open meadows near noon. Two of these birds, a male and a female, were by their organs, about to breed, and I have no doubt that it is here, if anywhere in Burma, that the first Woodcocks' eggs will be obtained. On the short grass near the pass my orderly also obtained a single water pipit (*A. spinoletta*) though the majority of the pipits here were Indian tree-pipits (*A. hodgsoni*).

On March 12, Messrs. Vernay and Cutting departed for Myitkyina and the rest of the expedition returned to Hparè. We spent three very wet days on the way in the oak forest near Zuklang at 8,500 feet and found it alive with wrens. We obtained a single chestnut-headed wren (*Tesia castaneocoronata*), which was not uncommon, and three of the rare long-tailed wren (*Spelaeornis souliei*). As a rule these birds were either quite invisible or offered a momentary chance at about thirty inches range.

On a bramble-covered hillside on the way to Hparè I saw Rippon's bullfinch, the black finch and the red-headed rose-finch at close quarters but they were difficult to shoot and still more difficult to retrieve though I managed to obtain a single specimen here of *Procarduelis nipalensis.*

Captain Kingdon Ward and myself then did a final camp close to the Hparè Pass. We saw here a blood pheasant and jays and obtained some of the tits and tree creepers we had got near the

Chimili, as also specimens of the Manipur Fulvetta which were about to breed. I had the good fortune to have a momentary glimpse of two fine male tragopans and a mouse-hare, but was stupid enough to miss at fairly close range with a shot gun and S. G., a head-on chance at a Michie's deer, on the hillside at 9,500 feet close to the Hparè Pass. Two specimens in the iron-grey winter coat had been brought in to us by natives but this was the first chance any member of the expedition had had of observing one. In flight it looked completely black with a very noticeable white 'flag'. The ordinary red barking deer certainly occurred up to 7,000 feet in the country traversed by the expedition and was seen or obtained both near Changyinhku and Gangfang. We also saw many sambhur tracks and picked up an immense shed horn at over 9,000 feet: one stag was seen but not obtained. On the last day I obtained the female of a pair of Ward's trogon which was about to breed and also shot a pair of the red-headed trogon at approximately the same altitude a mile away. A mole, a creature which Dr. Anthony had made many attempts to trap, was brought in by a Lashi from the pass and on our return to Hparè we found that Dr. Anthony had been extremely successful in obtaining a series of a rare *Nectogale,* a water shrew which the villagers caught by damming streams and poisoning them with aconite. Another mole was caught in a mouse-trap on the Pyepat ridge on the way home.

The return journey was uneventful, except for an immense gathering of black bulbuls on the Pyepat ridge. We obtained here both the dark and whiteheaded forms, as also the brown and scaly-breasted wrens: I saw enough to convince me that the Pyepat ridge and the 'Valley of Death' which adjoins it together form as fine a natural sanctuary for birds as any that exists in Burma. Blyth's parrotbill, the golden-breasted fulvetta, and the striated laughing-thrush were all obtained at Pyepat, as also one of a pair of the rare and silent *Columba pulchricollis.* Tree creepers were seen but not obtained.

At Laukkaung immense numbers of the common rose-finch were seen feeding on wild raspberries and still more on the journey down the N'Mai valley. On the way down from Chipwi I paid a brief visit to the caves about four miles away of which I had heard sensational accounts from previous travellers in these hills. They are not by any means as extensive as I had expected; the entrance is a hole about 3 feet high and the largest cavern is about 30 yards long by 30 feet high. They harboured an immense congregation of bats and we secured a good series of two forms for Dr. Anthony.

At Tanga, on the journey down, two very large flocks of Short-toed Larks were encountered on the small open space by the rest-house. They kept flying away south and returning, but we managed to secure five. They were *Calandrella brachydactyla,* which I had once previously obtained near Myitkyina itself.

We reached Myitkyina on April 12. We had collected 1,000 mammals and 1505 birds. The mammals were mainly small ones and, though many were new to Burma, and others of extreme

rarity, it is impossible for me to define here the actual results, with which Dr. Anthony expressed himself well satisfied. The birds consist of 299 species (not counting racial forms in some of which we got 2 in different parts of the hills. Of these 53 I had not previously met with in Burma and of 23 I could not find any published Burma records.

PART II.

The following are the more important birds obtained. The nomenclature is that used by Dr. Ernst Mayer. Of those marked* there are no previously published Burma records.

Urocissa fl. flavirostris.

6 specimens between 5,500 and 9,500 ft.
A rare hill and forest form of *U. erythrorhyncha.*

Nucifraga caryocatactes yunnanensis.

1 at 8,700 ft.

Parus ater æmodius.

2 at 10,500 ft.

Parus rufonuchalis beavani.

5 at 9,500 to 11,000 ft.

Parus d. dichrous.*

4 at 10,500 ft.

Sylviparus m. modestus.

14 between 8,500 and 10,500 ft.

Aegithaliscus iouschistos bonvaloti.

6 between 7,000 and 10,500 ft.

Conostoma æmodium.*

3 between 9,200 and 11,000 ft.

Paradoxornis unicolor.

7 between 9,200 and 11,000 ft.

Paradoxornis p. poliotis.

10 between 8,000 and 9,000 ft.

Paradoxornis fulvifrons albifacies.*

2 at 10,500 ft. in cane.

Sitta h. himalayensis.

8 specimens. The common nuthatch above 8,000 ft.

Garrulax ocellata similis.*

2 in oak-forest at 8,700 ft.

Garrulax rufogularis.

1 specimen.

Trochalopterum subunicolor.

8 specimens. Common at 7,000 ft. on Pyepat ridge.

2

Trochalopterum affine oustaleti.
21 specimens. The common Laughing-Thrush up to 9,500 ft.

Grammatoptila striata austeni.
6 specimens. 5,000 to 7,500 ft.

Babax l. lanceolatus.
1 specimen. a rare or very shy bird.

Xiphiramphus superciliaris forresti.*
2 specimens (? 7,000 ft.)

Alcippe cinerea.
3 specimens : common on Pyepat ridge at 7,000 ft.

Fulvetta vinipectus perstriata.
22 specimens. the common small bird of the cane above 9000 ft.

Fulvetta cineriiceps manipurensis.
8 specimens. a bird of scrub jungle between 5000 and 8000 ft.

Fulvetta chrysotis forresti.
4 specimens : usually seen with Suthora poliotis at about 7000-8000 ft.

Leioptila desgodinsi.*
1 specimen at Htawgaw. (6000 ft).

Leioptila pulchella cæruleotincta.
23 specimens. Common from 7,000 to 9,000 ft.

Actinodura nipalensis saturatior.
26 specimens. Common from 8000 ft. in oak and rhododendron forest.

Yuhina g. gularis.
25 specimens, the commonest bird of the oak forest above 8,000 ft.

Yuhina diademata.
5 specimens.

Yuhina occipitalis obscurior.*
4 specimens.

Yuhina nigrimentum.
1 specimen.

Yuhina bakeri.*
1 specimen.

Cutia nipalensis.
13 specimens. Usually in oak forest above 7,000 ft.

Pteruthius erythropterus yunnanensis.*
9 specimens.

Pteruthius m. melanotis.
8 specimens, mainly in oak forest above 8,000 ft.

Pteruthius xanthochloris pallidus.*
3 specimens—10,000 to 11,000 ft.

Pteruthius r. rufiventer.*
6 specimens, 6,000 to 8,700 ft.

Microscelis sp.
31 specimens, comprising black, dark-grey and whiteheaded forms.

Certhia discolor shanensis.
3 specimens in oak and alder forest at 7,200 ft.

Certhia nipalensis.*
5 specimens, 8,000 to 10,000 ft.

Troglodytes t. nipalensis.
4 specimens.

Spelæornis souliei.
3 specimens at 8,000 ft.

Spelæornis longicaudatus kauriensis
2 specimens.

Pnœpyga a. albiventer.
3 specimens 7,000 ft.

Cinclus cinclus.*
1 at 9,200 ft. near Imaw Bum.

Brachypteryx stellatus.*
1 at 7,000 ft. in bamboo.

Microcichla s. scouleri.
1 specimen.

Phœnicurus frontalis.
16. The common redstart of the middle hills between 4,500 and 7,000 ft.

Phœnicurus schisticeps.*
2 specimens, 1 at 10,500 ft.

Tarsiger chrysaeus.
2 specimens. Others seen at 7,000-8,000 ft.

Tarsiger cyanurus.
28 specimens: one of the few common birds of the road from 4,000 to 7,000 ft.

Tarsiger indicus yunnanensis.
11 specimens, 9,000 to 10,000 ft. in cane.

Turdus rubrocanus gouldi.
7 specimens, and others seen 5,000 to 7,000 ft.

Turdus naumanni eunomus.
2 specimens.

Turdus obscurus.
12, all in November and December along the mule-road.

Turdus dixoni.
8 specimens all along the mule-road.

Turdus m. mollissimus.

1 specimen.

Prunella strophiata.

2 specimens: not uncommon in rocks and bracken at 7,000 ft.

Cyornis concretus cyaneus.

1 specimen.

Horeites fortipes.

3 specimens: common in spring 6,000-7,000 ft.

Phylloscopus proregulus.

5 specimens.

Phylloscopus pulcher.

1 specimen.

phylloscopus subaffinis.

15 specimens.

Perissospiza icteroides.

3 specimens at 9,200 ft.

Pyrrhula erythaca.

13. Common on budding willow etc. at 7,000 to 8,000 ft. in February.

Pyrrhoplectes epauletta.

1, in a flock at 6,000 ft. Others seen at 7,000 ft.

Loxia curvirostra.

3 specimens, 5,000 to 7,200 ft.

Hœmatospiza sipahi.

One shot, another seen at 5,000 ft.

Propyrrhula subhimachala.

4 specimens, not uncommon above 6,000 ft.

Carpodacus edwardsii.

10 specimens from 7,000 to 9,500 ft.

Procarduelis nipalensis.

2 specimens, one at 7,000 ft.

Spinus thibetanus.

4 specimens: several large flocks seen 5,000 to 7,000 ft.,

Emberiza tristrami.

1 at 6,000 ft. on Pyepat ridge.

Emberiza cia.*

2 near Panwa pass, 7,000 ft.

Emberiza elegans.

3 obtained at Gangfang and Htawgaw and seen in two other places all above 5,000 ft.

Delichon nipalensis.

7 specimens. Large flocks near Gangfang at 5,000 ft.

Delichon dasypus cashmiriensis.
3 out of a large flock frequently seen at 4,000 ft. near Lankkaung.

Anthus spinoletta japonicus.*
One near Panwa pass at 7,500 ft.

Alauda arvescens.
14 specimens. In pairs singing near Panwa pass.

Calandrella rufescens.*
1 specimen.

Calandrella brachydactyla.
1 specimen.

Aethopyga dabryi.
7 specimens. Common at 7,200 ft. near Panwa pass.

Dicæum concolor.
1 specimen in N'Mai Valley.

Pitta oatesi.
1 specimen.

Hypopicus hyperythrus.
1 specimen at 7,200 ft. near the Panwa pass.

Dryobates major.
5 specimens.

Dryobates darjillensis.
5 specimens.

Dryobates cathparius.
4 specimens.

Blythipicus pyrrhotis.
2 specimens at 6,000 to 7,000 ft.

Thriponax javanensis.
1 specimen at 7,000 ft.

Pyrotrogon wardi.
5 specimens, 5,000-7,000 ft.

Chætura gigantea.
1 specimen.

Buteo burmanicus.
1 specimen.

Accipiter gentilis.
1 specimen at 250 ft.

Accipiter trivirgatus.
2 specimens at 5,000 ft.

Accipiter virgatus.
1 specimen at 5,000 ft.

Columba pulchricollis.

2 and others seen on Pyepat ridge, 7,000 ft.

Phasianus colchicus.

6 specimens.

Chrysolophus amherstiæ.

1 specimen.

Ithaginis cruentus kuseri.

3 specimens 9,500 ft.

Porzana bicolor.

1 at 5,000 ft.

Recurvirostra avocetta.

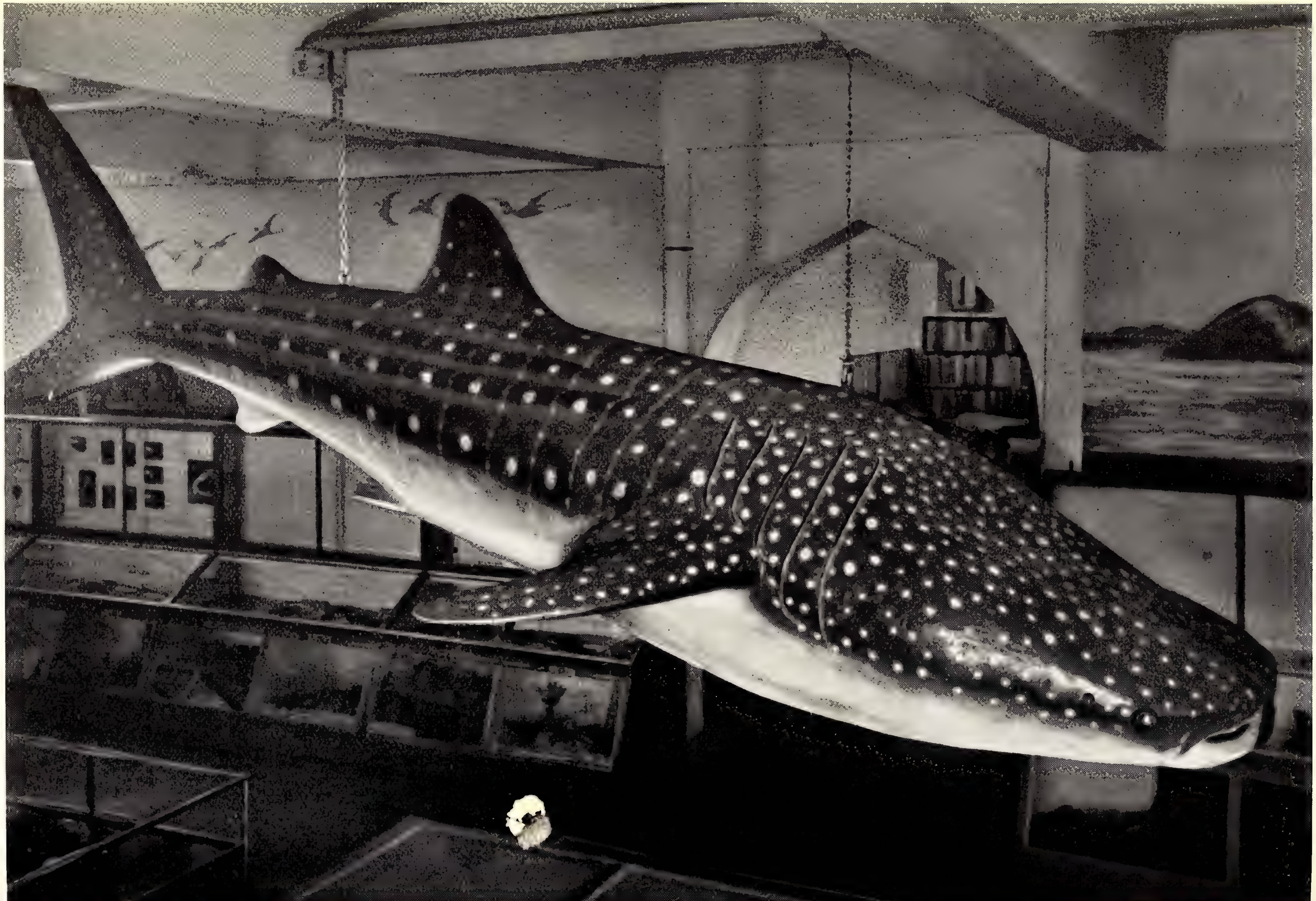
1 near Waingmaw.

Ibidorhyncha struthersii.

1 near Gangfang, 5,000 ft.

Capella solitaria.

1 near Gangfang.



Whale Shark (21′ 6″) caught in fishing nets 15 miles from Bombay, 7th February 1938.

Photo of a cast in the Prince of Wales Museum, Bombay.

THE WHALE SHARK (*RHINEODON TYPUS* SMITH) IN INDIAN COASTAL WATERS.

WITH NOTES ON ITS WANDERINGS IN OTHER AREAS.

BY

S. H. PRATER, C.M.Z.S.

Curator, Bombay Natural History Society.

(With 1 map and 7 plates).

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INTRODUCTION.

The Whale Shark (*Rhineodon typus*), the largest of existing sharks, grows to a length of over 50 ft. It ranges through the tropical and sub-tropical waters of the Pacific, Indian and Atlantic Oceans. Mr. E. W. Gudger (1934) has brought together, from numerous sources, records of whale sharks, captured or seen in the wide area of their distribution. As regards the coastal waters of India, his paper adds considerably to the single record noted by Day in his volume on Fishes in the *Fauna of British India* series. Enquiries subsequent to the capture of a whale shark off the Ratnagiri coast in October 1938, have enabled me to add a number of new records to the list made by Gudger. The following notes on the occurrence and distribution of whale sharks in the coastal waters of India include previous records noted by

Gudger, supplemented with the data now made available. I have numbered the records in the order in which they are listed in the table which appears on p. 260.

Distribution of the Whale Shark in Indian Coastal Waters.

West Coast of India.

Sind.

No. 1. In his introductory note to the Order, Selachoidea, Day (1889) refers to Dr. Buist's (1850) note on shark-fishing at Karachi, where an export trade in sharks' fins was then, and is yet carried on. Dr. Buist describes the methods employed in the capture of a 'basking shark', known to the local fishermen as the *mhor*, which is usually found floating or asleep on or near the surface of the sea. Dr. Buist's informant told him that the *mhor* is often 40 to 60 ft. in length, with a capacious mouth reaching 4 ft. in width. As a result of enquiries made at Karachi, I ascertained that fishermen still know of a fish called *mhor* which, as Buist describes, is occasionally harpooned while basking on the surface of the sea. My correspondent was unable to give any figures as to the actual number of *mhor* caught. He was told by the fishermen that in some years they took several of these sharks and in others they were not seen at all, but as a *mhor* realised about Rs. 15 from the oil obtained from its liver, it was hardly worthwhile making special efforts to capture them.

The question arises what species of shark is known as the *mhor*?

Gudger (loc. cit.) commenting on Buist's description of the general characters and habits of the fish concludes that the *mhor* is none other than the whale shark. He says:—

> 'though no mention of spots is made, its gigantic size and cavernous mouth would seem to make it the Whale Shark, which like *Cetorhinus*, the true Basking Shark, is frequently found at the surface of the water. Further more *Cetorhinus*, which has a comparatively small mouth, has (so far as I know) never been taken in the North Indian Ocean. It is primarily a cold water shark. The Mhor must have been the Whale Shark'.

While Buist made no reference to spots—an obvious and striking character in the colouration of the whale shark—the term *mhor*, the local name for the fish, is in itself descriptive of this character (vide notes on local names p. 270). Apart from this, actual confirmation of Gudger's views as to the identity of the *mhor* is now obtained by the recent captures of so called 'Basking Sharks' at Karachi, which proved to be whale sharks.

The history of these captures is as follows:—

No. 2. Mr. B. D. Ashworth, in a letter to the *Times of India*, (kindly forwarded to me by the Editor) enclosed two photographs of a Whale Shark caught at Karachi in April 1932. The fish was harpooned by fishermen from a small boat and, after a protracted struggle, was brought under control and killed with an axe. The axe marks on the fish's head can be seen in the photo (Plate II, No. 1).

No. 3. On the 27th March 1937, Capt. Heygate of the 1st Bttn., Royal West Kent Regiment and Lt. Heirsch, Royal Scot's Fusiliers harpooned a whale shark, 18 ft. in length, off Cape

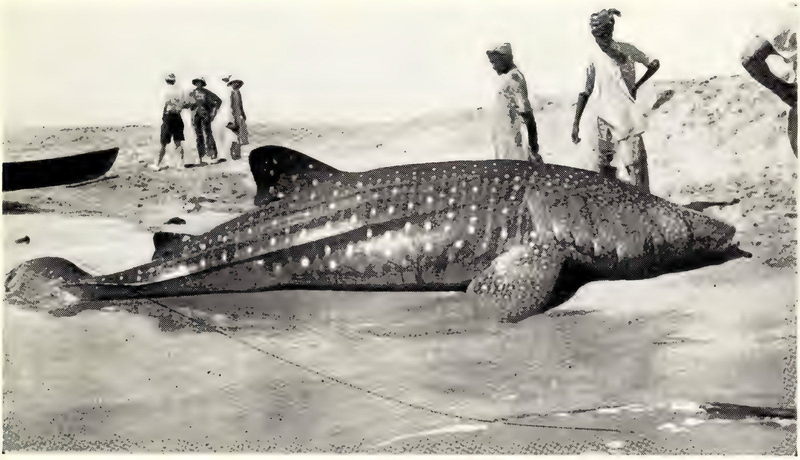
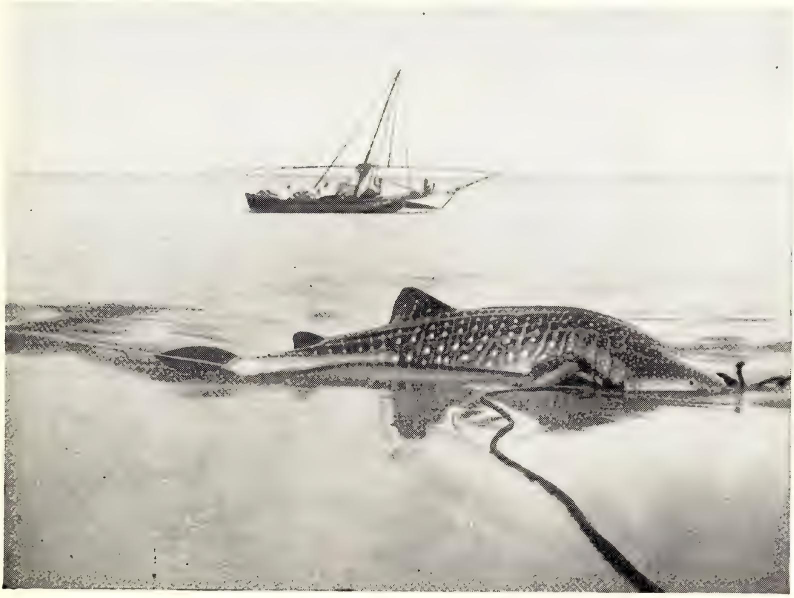


Photo by *B. D. Ashworth.*

1. Whale Shark caught at Karachi, April, 1932.



2. Whale Shark (18 ft.) harpooned by Capt. Heygate and Lt. J. L. Heisch off Cape Monze, Karachi, 27th March, 1937.

Photo by P. K. Gogote *The Times of India.*

Whale Shark (20 ft.) caught in the fishing nets near Jaygad, Ratnagiri, Bombay Province, on 3rd October, 1936.

Monze, some 20 miles north of Karachi. The shark was towed into Karachi harbour. The photo shows the fish after it was beached (Plate II, No. 2).

No. 4. In April of the same year, the two officers named above, harpooned a scond specimen some three miles off Karachi. The harpoon worked loose and the fish got away. They were however able to get a good view of the shark, when it was swimming on the surface of the sea, and again when beneath their boat. They state, in a note sent to me, that it was identical with their first capture having the 'same spotted skin and spade-shaped head'.

Bombay Province.

No. 5. On October 3rd, 1936, a whale shark, caught in the fishing nets near Jaygad, Ratnagiri, about 100 miles south of Bombay, was brought ashore by the fishermen. Mr. P. K. Gogote, the local correspondent of the *Times of India,* sent a photograph of the fish to this paper with a note saying that the fish was over 20 ft. in length. He adds—

> 'the special feature of this fish was that it could not be cut, i.e. the cut effected showed no trace owing to the rejoining of the skin'.

Owing to the elasticity of the skin and the deep underlying layers of fat, any incisions made in the body of this fish rapidly close up and leave little or no trace. The unexpected result so impressed the fisherfolk, that they returned the fish to the sea rather than be held accountable for its life. Mr. Gogote says that it was towed into deep water and released 'owing to superstitious fears.' A photo of the fish, originally published in the *Times of India,* is reproduced here. (Plate III).

No. 6. On Sunday, February 13th, 1938, a whale shark, 21′ 6″ in length, was caught by fishermen 15 miles from Bombay. It had fouled their nets and was towed into Sassoon Dock, Bombay. I was informed of the capture of this fish by Dr. S. B. Setna, Fisheries Officer, Bombay. When we arrived at the dock a great crowd of people had already assembled round the shark, which had been dragged up the slip way. An enterprising cooly *mukadum* (overseer) had covered it with a tarpaulin and was now demanding a fee of 1 anna from all who desired to see the 'god' under the canvas. To impress doubters, preliminary homage had been paid to the deity, with a sprinkling of flowers and turmeric powder, and the burning of incense sticks. It is a common practice when whales or large fish are cast up upon our coasts or taken out of the sea. The derelict becomes *'massa dev'* the fish-god and receives homage from all believers to the material gain of the presiding genius. A complete plaster mould was taken of this fish, over 2,000 lbs. of plaster being used in the process. Its cast is now exhibited in the Fish Gallery of the Prince of Wales Museum. To present the correct contours and to overcome as far as possible the distortion of form arising from a heavy body pressed against the ground, the undersurface of the fish and parts of the mid-body were remodelled. The cast is as true and accurate a representation of this rare fish as is obtainable (Plate I). The Museum is greatly indebted to Mr. J. R. Kaka

who presented this fish to the Museum, to Dr. S. B. Setna and to the Port Trust Authorities for the assistance which they gave to the Museum staff.

No. 7. On Tuesday, 16th January 1940, a whale shark (male) 18 ft. in length was landed at Chowpatty beach, Bombay. It was seen on the night of the 15th several miles out at sea, floating on the surface. The shark subsequently fouled the nets of the fishermen who secured it and hauled it ashore. (Plates IV and V).

Travancore Coast.

No. 8. Mr. R. Shankara Narayan Pillay (1929), in his list of the fishes taken in Travancore between 1901 and 1915, says that a whale shark, measuring 29 ft. in length was stranded at Trivandrum in 1900.

No. 9. Mr. Pillay also referred (loc. cit.) to the cast of a 13 ft. 7 ins. specimen, now exhibited in the fish gallery of the Trivandrum Museum. Mr. R. V. Poduval, the Curator of the Museum has since sent me the history of this shark. It was caught in fishing nets off Travancore in February 1909.

No. 10. In a letter, Mr. Poduval provides a further record of the capture of a whale shark in March 1934, when a specimen, 13 ft. in length, was captured off Trivandrum. He adds that the capture of small specimens like this is by no means uncommon.

Ceylon.

No. 11. The earliest reference to the occurrence of the whale shark in the coastal waters of Ceylon, which I have been able to find, is by Sir Emerson Tennant (1801). Writing of the export trade in sharks' fins from the gulf of Mannar, he says that the skin of the 'Basking Shark' is also sent to be converted into shagreen'. The basking shark referred to by Tennant could be none other than whale shark, as we have no evidence of the occurrence of the true basking shark (*Cetorhinus*) in these warmer seas.

No. 12. The second reference is by Capt. James Stewart (1862). In his account of the Pearl Fisheries of Ceylon he says that sharks are common and that on two occasions his attention was called to 'spotted ones' of such monstruous size as to make the common sharks at their sides look like 'pilot fish'. The 'spots' and the size again indicate that Stewart's monster sharks were whale sharks.

No. 13. Haley (1883) recorded the capture of a whale shark, 23′ 9″ long, which was taken in the fishing nets at Moratuva, 12 miles south of Colombo on the 11th January, 1883. The specimen was mounted and is now exhibited in the Colombo Museum. This is the record referred to by Day in his *Fauna* volumes, then the only example known from the Indian waters.

No. 14. The capture of a second specimen 18′ long was again recorded by Haley (1884). It was taken off Negombo, north of Colombo. The skin was sent to the British Museum and is now exhibited there.

No. 15. A third capture from Ceylon, a 14′ 5″ example, taken

Photo by *Felicitas Studio.*

Whale Shark (18 ft.) landed at Chowpatty Beach, Bombay, 16th January 1940.

Photo by Felicitas Studio.

Whale Shark ([illegible]) landed at Chowpatty, Bombay, 26th January [illegible]

off Bampalapittya (a southern suburb of Colombo), was recorded by Thurston (1894).

No. 16. To these records of the actual taking of whale sharks in the seas round Ceylon, we can now add a fourth. Mr. P. E. Deraniyagala (1936), Acting Director of the Colombo Museum, in an article on Big Game Fishing off Ceylon says, that on the 10th July, 1935 the *S. S. Katori Maru* ran into a whale shark off the Ceylon Coast. According to the Captain the specimen was 40′ long.

> 'It was the size of a whale, differing from that animal in shape, spotted like a leopard in a very beautiful manner. It came along under the stern of the ship during a calm, we had a magnificent opportunity of viewing it. It had a large dorsal fin, which it moved about with great rapidity when angry, in consequence of the large stones we threw down upon it, rashly for it possessed sufficient strength to have broken the rudder and to stove in the stern of the ship. Several large fish (seemingly dog-fish), about a cubit in length and upwards, were gamboling about the monster entering its mouth at pleasure and returning to the water again. The mouth was very large. Dorsal fin black or dark brown. Tail also boldly covered with brown spots like a leopard. Head, lizard-shaped.'

Mr. Deraniyagala in his letter to me says, that since his article appeared in print, there was at least one other *Rhineodon* struck by a ship in Ceylon waters, but unfortunately he had kept no record of it.

No. 17. Gudger (1940) records the ramming of a whale shark by the Dutch Ship '*Johan van Oldenbarnvelt*' about 15-18 miles off Colombo on the 24th November, 1932. Second Officer H. W. Hemmes, who reported the incident, says that:—

> 'The bow of the ship had pierced into the body of the shark for about three feet. The part of the ship with the tail hanging was on our starboard side and was about 25 ft. long. The fish was bleeding, but was apparently dead. When the ship got clear of the fish, the body dropped down into the water.'

East Coast of India.

No. 18. Foley's (1835) account of an unusual sea-monster in the Bay of Bengal, is, as far as I know, the earliest published reference to this shark. On a voyage to Madras, when his ship was presumably nearing port, he saw what he describes as an 'unusual sea monster' of the size of a whale, but differing from that animal in shape. He refers to its large mouth and to its body covered with brown spots like a leopard. Foley's description is sufficient to establish the identity of his monster.

No. 19. The second record from the Bay of Bengal is by Thurston (1890). He writes of a specimen 20′ long which was washed ashore at Madras in February 1889. In a subsequent publication (1894) he corrected the measurement to 22′.

No. 20. The third record from the Bay of Bengal was noted by R. E. Lloyd (1908) who reported the harpooning of a whale shark swimming on the surface at the mouth of the Hoogly, on March 23, 1908. The specimen was presented to the Indian Museum, Calcutta.

The various records of whale sharks from the coastal waters of India are shown below in tabular form. Records previously noted by Gudger (1934) are marked with an asterisk.

RECORDS OF WHALE SHARKS IN THE COASTAL WATERS OF INDIA AND CEYLON.

West Coast of India and Ceylon

Locality	Date	No.	Reported by	Recorded by
*1. Karachi ...	...		...	Dr. Buist, 1850.
2. ,, ...	April, 1922 ...	1	B. D. Ashworth.	S. H. Prater.
3. ,, ...	27th March, 1937...	1	Capt. Heygate ...	,,
4. ,, ...	April, 1937 ...	1	,, ...	,,
5. Bombay ...	13th February, 1938 ...	1	Dr. S. B. Setna...	,,
6. ,, ..	1st January, 1940.	1	J. Jacobs ...	,,
7. Jaygad ...	3rd October, 1936.	1	P. V. Gogote ...	,,
*8. Travancore.	... 1900.	1	...	S. N. Pillay, 1929.
*9. ,,	February, 1909 ...	1	...	S. N. Pillay, 1929.
10. ,,	March, 1934 ...	1	S. K. Poduval ...	S. H. Prater.
*11. Moratuva, Cyelon ...	January, 1883 ...	1	...	Hailey, 1883.
*12. Negombo, Ceylon ...	,, 1890 ...	1	...	,, 1890.
*13. Colombo ...	February, 1889 ...	1	...	Thurston, 1890.
14. Off Ceylon ...	...	...	...	Tennant, 1861.
*15. Gulf of Mannar ...	...	...	...	Stewart, 1862.
16. Off Ceylon...	...	1	...	Deraniyagala.
17. Off Colombo.	24th November, 1932 ...	1	...	W. E. Gudger, 1940.
Total, West Coast ...		14+		

East Coast of India and Ceylon

Locality	Date	No.	Reported by	Recorded by
*18. Madras ...	February, 1889 ...	1	...	Thurston, 1890.
*19. ,, ...	...	1	...	Foley, 1835.
*20. Mouth of Hoogly ...	23rd March, 1908...	1	...	Lloyd, 1908.
Total, East Coast ...		3		

A reference to the table printed above shows firstly, that practically all the recorded occurrences of whale sharks in our coastal waters are from the West Coast of India and Ceylon. During the long period over which these records extend, there are only three records from the East Coast and fourteen actual records from the West Coast of India and Ceylon, exclusive of references to specimens seen in this area.

The second fact which emerges is, that practically all the records fall between the months of January and April. In considering the distribution of the Whale Shark in our coastal waters two factors have then to be accounted for—

1. Their seasonal appearance on our coasts between January and April.

2. Their occurrence mainly on the West Coast of India and Ceylon.

To my mind, these factors provide important clues to an understanding of the movements and wanderings of these fishes. I am of opinion that the appearance of whale sharks on our coasts, during the particular season when they occur, is associated with the special abundance of their food at this particular period. Secondly that, the limitation of their range, mainly to the west coast of India and Ceylon, is due to the particular direction and movements of surface currents in the Bay of Bengal and the Arabian Sea at this period. Before taking up the evidence in support of these views, it is necessary to consider briefly the food and feeding habits of the Whale Shark.

Food of Whale Sharks.

Gudger (1915) has brought together such observations as have been made on the food of the Whale Shark. Because of its minute teeth, it was first thought that these great sharks were purely herbivorous. The large masses of algae found in the stomach led Wright (1870) to this conclusion. It is now definitely known that the Whale Shark, like the Basking Shark, feeds on plankton, strained out of the water by its peculiar gill apparatus. In some sharks, fringe-like structures, located on the pharyngeal walls, are modified to form what are known as 'gill-rakers'. In the Basking Shark and the Whale Shark, the gill-rakers are remarkably specialised to form a highly complex straining apparatus. They are closely set in a row on the inner extremity of the gill-arches, and, as they project into the inner cleft, leading to the gullet, they function effectively as a strain or sieve to food or water entering the alimentary tract. Their function is thus similar to the function of the long hair-like fringes on the baleen plates of the whale-bone whales, and as such they provide a striking example of parallelism—of the evolution of similar structures, designed to serve the same ends in totally unrelated groups of animals.

The manner of feeding of these great sharks is simple. Smith's (1849) account of the feeding habits of the Whale Shark is similar in every way to the description of the feeding habits of the Basking Shark. Both sharks swim or float leisurely with the mass of drifting plankton, and with widely open mouth, take in great quantities of water, and with it, the myriads of floating organisms it contains. On the closure of the mouth, the water is forced out through the gill-clefts, leaving the food adhering to the inner walls of the gullet and to the sieve-like gill-rakers.

During the process, masses of algae and other flotsam may be taken in. The stomach of the specimen landed at Sasson dock, Bombay, contained a mass of green algae. Kishinouye (1901) records that an oaken pole was found in the stomach of a specimen caught near Japan. The diet of the basking shark is known to consist almost entirely of zoo-plankton—of shrimp-like crustaceans, and other minute animal organisms, which swim about on the surface of the sea, and which, at certain seasons, constitute the dominating element of the plankton. Whale sharks also derive their nourishment from minute crustacean and other animal forms which, as will be presently shown, form the dominating element in the plankton of our off-shore waters when these sharks visit our coasts.

Influence of Plankton Outbursts on Movements of Whale Sharks.

Arabian Sea. Such investigations as have been made of plankton in Indian waters show, that in the Arabian Sea and the Bay of Bengal, plankton productivity is wholly dominated by the alternation of the north-east and south-west monsoon and, that plankton outbursts are far more seasonal in our seas than in most tropical waters. Writing of plankton on the Malabar Coast, Hornell and Nayudu (1923) have shown that on this coast there are two peak periods of productivity. There is a maximum production of plant forms (phyto-plankton) between May and September, in response to conditions brought about by the south-west monsoon; while a second outburst, takes place between January and February, favoured by conditions produced by the north-east monsoon. Factors favouring the first outburst are the vast quantities or organic and inorganic matter washed into the sea by the south-west monsoon floods, which bring to the surface waters the manurial elements necessary for plankton growth. Reduced salinity, occasioned by the out-flow of these flood waters, also brings about that increased stability which is favourable to plankton growth. The calm conditions which prevail during the north-east monsoon, while they again favour the growth of phyto-plankton, appear to be also favourable to the development of animal organisms (zoo-plankton), which, during this season, constitute the dominating element of the plankton. Sewell (1913) states, that a study of the plankton constituent in Indian seas leads to the conclusion that, compared with temperate seas (North-Atlantic), marine animal organisms occur at a somewhat later period, and that there seems to be a general tendency for marine organisms to have their breeding season during the cold weather rather than during the hot months of the year. The reason suggested is the disturbed conditions of the sea during the south-west monsoon. Hornell and Nayudu's investigations of the off-shore plankton on the Malabar Coast support this view and reveal the abundance of zoo-plankton during the cold weather. They write :—

'In November copepods begin to appear in much greater numbers than at any time since the preceding May, and finding an abundance of food, multiply very rapidly, with them in November, appear swarms of Napuli and a host

of other rapacious organisms to feed upon the diatoms and dino-flagellates. *This miscellaneous assemblage remains the characteristic feature of the off-shore plankton till the rains in May kill or drive away from the shore these forms and replace them with swarms of diatoms.* (Italics are mine.)

It is shown that there is clearly a super-abundance of zoo-plankton in the off-shore waters of the Malabar Coast between January and April, when whale sharks appear. Conditions on the Malabar Coast are repeated on the Bombay Coast. Through the courtesy of Dr. Lele of the Royal Institute of Science, Bombay, I had the opportunity of consulting an unpublished thesis by a Miss A. P. Gae, recording month to month plankton investigations carried out at Bombay between October 1932 and March 1934. These investigations, again reveal an abundance of zoo-plankton between January and March, enriched, the author observes, by forms not present at other seasons of the year. The investigations revealed that copepods, in particular, swarm in myriads during these months. We have no data of plankton on the Sind Coast; but the seas in the neighbourhood of Karachi must receive a considerable quantity of nutrient matter brought by the river Indus, and probably provide a rich field for the development of plant forms and the succeeding invasion of animal organisms.

These optimum conditions of food supply are repeated off the west coast of Ceylon and in certain tracts of the Arabian Sea during the North-East Monsoon. Thompson and H. Carey Gilson (1937) in their report on chemical and physical investigations in the Arabian Sea, carried out by the John Murray Expedition, express the view that, with the resumption of calm conditions in September, there is a considerable growth of phyto-plankton, particularly where upward water movements cause a renewal of nutrient-salts in the surface layers. This occurs principally near Seychelles and in the strong currents near the African coast about Lat. 1.3° N., which sweep northwards to the Gulf of Aden and the coast of Arabia. Note, that the two areas where whale sharks have been recorded from the Arabian Sea, i.e., Seychelles and the mouth of the Gulf of Aden are, as the authors show, areas of great plankton productivity. Recorded occurrences from the Straits of Babel Mandeb and the southern extremity of the Red Sea have probably a similar explanation.

Equally significant is the fact, that whale sharks have never been recorded from the Persian and Mekran coasts. This has been described by Sewell as an area of scanty plankton production—a 'desert area' as far as plankton is concerned.

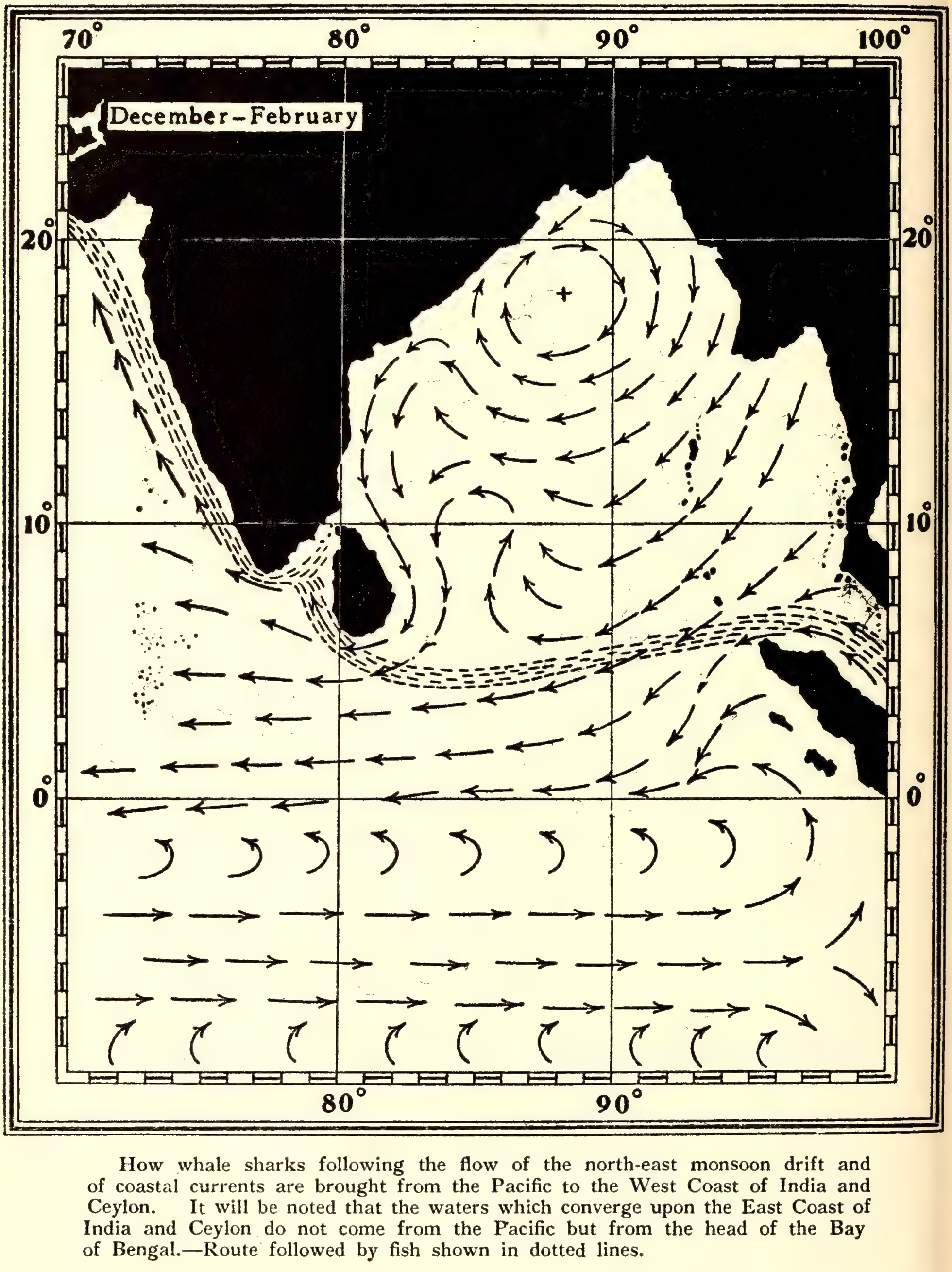
Plankton productivity in the Bay of Bengal. Menon (1931) has shown, that owing to the more limited influence of the south-west monsoon, favourable conditions for the production of plankton are not produced on the East Coast till September, when productivity commences, reaching its peak in January. From thence on there is a slight decline followed by an abrupt rise in March, which reaches its maximum in May. These phyto-plankton outbursts are, as always, followed by a rich influx of zoo-plankton, which, commencing in October, reaches maximum conditions in December, January and February and then commences to decline.

It has been shown, that between December and March, the off-shore waters of India and Ceylon provide, a super-abundant harvest of animal organisms, which become the dominating element in the plankton. The abundance of this drifting food attracts to our coastal waters, during this season, numerous surface feeding fishes, such as devil rays, sail fish, etc., and, among them, whale sharks, whose appearance on our coasts coincides with this season of plenty. There follows the second point for consideration :—If whale sharks visit our waters because of the abundant food supply why do they confine themselves mainly to the West Coast?

The Influence of Surface Currents on the movements of Whale Sharks.

Why are whale sharks so rare on the East Coast, where at the time of their migration, food conditions are as favourable as on the West Coast? Why again have they never been observed in the eastern reaches of the Bay of Bengal, or along the coasts of Burma and Tenasserim? Data provided by Sewell (1913) show that plankton decidedly increases in these waters from early November to the beginning of January, and that the plankton is very rich in animal organisms, which provide food for these sharks. Yet, during a period extending over a century, we have only three records from the East Coast, and none from the shores of Burma and Tenasserim. The explanation, I believe, is to be found in the direction and movements of the surface currents in the Bay of Bengal and along the coasts of India and Ceylon at the time when whale sharks commence their seasonal visitation to our waters. Gudger (1934), in explaining the appearance of whale sharks on the coasts of India, says that during the northern summer (i.e. June to August) there is a monsoon drift from the south-west to the north-east, which might carry whale sharks from the Seychelles Archipelago, where they are known to be permanently resident, to India. The answer to this is, that whale sharks do not visit our coasts between June and August, when the south-west monsoon is established. As shown by the records, their visits are timed between January and March, during the north-east monsoon. Sewell (1937) has indicated, that the north-east monsoon is a period when the bulk of the waters of the Arabian Sea converge upon the African coast. The movement of these sharks from Seychelles to India, at this season, would be contrary both to wind and surface currents. The sharks which visit the coasts of India during the north-east monsoon, if they follow the drift of the currents, must come to us not from the West but from the East. This, an alternative route suggested by Gudger, is the correct one. Sewell (loc. cit.) states, that with the establishment of the north-east monsoon (about December), there is a strong flow of water from the Pacific into the Indian Ocean through the Straits of Sumatra. This current known as the north-east monsoon drift, moves across the Andaman Sea and the lower reaches of the Bay of Bengal and sweeps by the south coast of Ceylon. Whale sharks, moving with this drift, would arrive off the south coast of Ceylon. From

SURFACE CURRENTS OF THE BAY OF BENGAL: (after Sewell).



How whale sharks following the flow of the north-east monsoon drift and of coastal currents are brought from the Pacific to the West Coast of India and Ceylon. It will be noted that the waters which converge upon the East Coast of India and Ceylon do not come from the Pacific but from the head of the Bay of Bengal.—Route followed by fish shown in dotted lines.

this area a coastal current, which sweeps up the west coast of Ceylon, at this time of the year, would bring them to the Gulf of Mannar; from the Gulf, their progress northward, along the west coast of India, would again be aided by the coastal current, which at this season, begins to run from south to north. This north flowing coastal current would bring these sharks to the coasts of Travancore, Bombay and Sind.

The question arises, why whale sharks, if they come from the Straits of Sumatra, across the Bay of Bengal, do not first converge upon the east coast of India and Ceylon. The answer here again is to be found in the direction and movements of surface currents in the Bay of Bengal, at the time of their westerly migration. Sewell (1938), has given in some detail, an account of the movements of surface currents in the Bay of Bengal at various periods of the year. A reference to his map, which is reproduced here, will indicate that the north-east monsoon drift from the Straits of Sumatra does not flow towards the east coast of India. It runs in lower latitudes. It crosses the lower reaches of the Bay of Bengal and flows past the south of Ceylon. The waters, which impinge upon the Coromandel coast at this time of the year, (i.e. December to February), do not come from the Straits of Sumatra at all. They come from the head of the Bay, where, owing to the north-east monsoon winds, the surface waters are driven off the coasts of Burma, westwards across the Bay, to the northern section of the Coromandel coast. There, due to the rotation of the earth, and the configuration of the coast, the westward flowing current divides; one branch flows northwards, producing at the head of the Bay a cyclonical circulation; the other flows southwards along the Madras coast and the east coast of Ceylon, then, rounding the island, the current flows up the west coast of the island to the Gulf of Mannar.

Whale sharks arriving at the south of Ceylon with the north-east monsoon drift would be aided by the northward movement of this coastal current up the west coast of the Island. On the other hand, progress up the east coast of Ceylon and India, as is seen, would be contrary to the flow of the coastal currents which at this time of the year run down the east coast of India and Ceylon from north to south.

We have one record of a whale shark off the Madras coast in February, and one in March, from the mouth of the Hoogly. A directional change which takes place in the surface currents in the Bay of Bengal, late in February or early in March, may explain these records. Sewell (loc. cit.) shows, that a decided change now takes place in the directional flow of the surface currents. Between February and March, a double cyclonal circulation sets in at the head waters of the Bay of Bengal, and a current sweeps up from below Ceylon up the Coromandel coast to the coast of Bengal. The reversal in the direction of the current at this time of the year, might easily bring whale sharks up the Madras coast to the mouth of the Hoogly.

It is impossible to assume, that the movements of so powerful a fish as the whale shark are controlled entirely by the direction

of the wind and the surface currents. But knowing the nature of their food, and their peculiar feeding habits, one might say, that these sharks, like some other surface feeding fishes,—sun fishes for example,—in the calm weather which prevails in our seas during the north-east monsoon, float with the currents in order to follow more easily their drifting food. It is clear, that a general convergence upon the coasts of India, from the surrounding seas, would not explain the peculiar and limited distribution of these fish on the coasts of India. The actual distribution of whale sharks on the coasts of India, the concordance of this distribution with the direction and flow of surface currents, during the season when they appear, is clear evidence of the influence of current upon their movements. The direction of surface currents explains how these sharks, coming to us with the inflow of waters from the Pacific, converge upon the west coast of India and Ceylon; why they are so rare upon the east coast, and why they have never been recorded from the coasts of Burma and Tenasserim. The purpose of their migration is indicated in the abundance of their food in these waters at this season. It is a time of the year when these waters contain an abundance of zoo-plankton.

Seasonal Movements of Whale Sharks in other Areas.

This seasonal movement of whale sharks to the coastal waters of India is apparently repeated in other areas. It is known that whale sharks, in numbers, visit the seas off the coast of Hondo, Japan, every summer. Again, at Seychelles, it has been observed that whale sharks visit the inshore waters every year between May and August. As on the coast of India, the movement appears to be associated with the particular abundance of planktonic food in the areas visited. I have not been able to consult any papers dealing with plankton productivity in the seas off Japan. Plankton conditions in Seychelles, an area of high productivity have not been studied between May and August. Nevertheless, there is interpretative evidence to indicate that the visits of whale sharks, both to Japanese waters, and to the inshore waters of Seychelles take place during periods of high plankton productivity. Whale sharks, it has been observed, visit the Japanese waters at a time when the *bonito* fishing is at its height. At Seychelles, it was noted, that the whale sharks come inshore between May and August with numbers of horse-mackerel and great shoals of sardines and other small fry. In the Bay of California, whale sharks were again observed at certain seasons in company with tunny.

Gudger explains the association of whale sharks with bonito, tunny and horse-mackerel (*Carangidae*) as the natural tendency of these smaller fishes to shelter or follow in the wake of giant fishes. Bonito and tunny, as is well known, will even follow passing ships. Be this as it may, the point relevant to the present discussion is the reason for the presence of these carnivorous fishes in great numbers in the areas visited by these sharks. The presence of highly predatory fishes like tunny, bonito and horse-mackerel in large numbers may be connected with breeding activities; but

may also be due to an equal preponderance of sardines, herrings, mackerel, and other small fry upon which they feed; and great assemblages of these small fishes can be ascribed to the existence of a super abundance of plankton. Hornell and Nayudu (loc. cit.) have shown how the visit of myriads of sardines to the inshore waters of the Malabar Coast coincides with a peak period of plankton productivity. Gadsden (1899) shows how in the seas round Aden in April, countless millions of small fishes appear, accompanied by troops of larger fishes chiefly, tunny, and albacore, and seer, which spend their time in preying upon the smaller fry. The presence of these smaller fishes in great numbers, in the Gulf of Aden is again explained by the abundance of plankton during this period, as is evidenced by the researches of the Murray Expedition. It is probable that whale sharks and hordes of smaller fish are attracted seasonally to Japanese waters by an abundant harvest of plankton, and the *bonito,* which swarm at this season, by the abundance of their prey.

Similar circumstances account probably for the abundance of whale shark, tuna and small fish off the coast of California about which Gudger (1940) writes. He says 'The small fish go in schools and are followed by both tuna and whale sharks'. The Bay of California and the west coast of America in general is known to be an area of rich plankton productivity.

From what has been written it will be seen that seasonal visits of whale sharks take place in various parts of the world; particularly in areas, such as the coasts of India, where plankton productivity is more definitely seasonal. The basking shark (*Cetorhinus*), which recalls the whale shark in its habits, also appears to undertake similar seasonal migrations. These movements, says Norman (1937), are as yet imperfectly understood, but there appears to be a regular annual migration along the west coast of Ireland to the Western Isles of Scotland and thence northwards, the shark approaching Ireland during the spring and reaching Norway during August. It is not improbable that the seasonal movements of these basking sharks are associated with the abundance of planktonic food in the area of their wanderings during this particular time of the year. The period of their migration coincides with the great spring outburst of plankton which in these highly productive waters is generally maintained till late in the summer; the plant outburst being shortly followed by the usual invasion of animal forms. Like the Whale Shark—the Basking Shark in its quest for its food follows the course of warm surface currents, in this instance the branch of the Gulf Stream which sweeping up the west coast of Ireland flows between the Faeroe and the Shetland Islands to the coast of Norway.

Seasonal migrations for purposes of feeding, aided by the flow of favourable warm currents, thus provide an explanation of whale sharks excursions into areas far from their natural habitat. These sharks, essentially fish of warm seas, have been recorded from as far north as New York and the Seas of Japan and from as far south as the Cape of Good Hope.

We must consider the coasts of India, and all such areas where

the occurrence of whale sharks is sporadic or seasonal as areas of nominal distribution, and as such, distinct from areas, where whale sharks are permanently resident.

Centres from which Whale Sharks migrate.

A study of the occurrence of whale sharks in the various parts of the world, brought together in Gudger's valuable paper, reveals an interesting fact. These sharks have been observed all the year round only in the island-studded seas of archipelagoes, where alone they are known to be permanently resident. In the Pacific, there are three centres in which whale sharks are known to occur all the year round. These are the East Indian Archipelago, the Philippine Archipelago, and the Islands at the mouth of the Bay of California. In the Indian Ocean, there is but one such area—the Seychelles Archipelago. In the Atlantic—the island studded seas of the Carribean and the Gulf of Florida are the only areas where these sharks are recorded as being permanently resident. We can then look upon these island seas as productive centres of distribution; centres from which a certain number of whale sharks, driven by exigencies of food supply or other causes, migrate regularly or irregularly into waters where food is plentiful, aided in their migration by favourable currents flowing outward from these sheltered seas.

From the circumstances of their distribution on our coasts, we know that the north-east monsoon drift brings the whale sharks to the coasts of India. This drift is caused by an inflow of waters from the Pacific, which come *via* the East Indian Archipelago, and enter the Indian Ocean through the Straits of Sumatra. Similarly, whale sharks from the Philippines, following the Kuoro Sivo current, would be brought to the coasts of Japan. These Archipelagoes, the Philippines and East Indies, appear to be the centres from which whale sharks, aided by the flow of currents, migrate seasonally to the waters of Japan and to the coasts of India. The same factors may provide the explanation for the occurrences of whale sharks along the west coast of Mexico, Panama and Peru. These areas of nominal distribution may derive their source from the Islands of the Gulf of California, where whale sharks are known to be permanenly resident. The Mexican coastal current would provide the aegis of the southward movement.

In the Indian Ocean, the Seychelles Archipelago would be the centre from which the whale sharks, recorded from the Gulf of Aden, and the Cape of Good Hope, travelled, assisted, in the former instance, by the northward flow of the East African coastal current, and in the latter by the westward flow of the Aghulas current, which sweeps past the Cape of Good Hope. In the Atlantic, the islands of the Carribean Sea and the Gulf of Florida are apparently the centres from which whale sharks migrate periodically along the eastern coasts of the United States, or southwards to Brazil and to the West Coast of Africa, which, like the west coast of America, is a region of rich plankton productivity.

Judging from their appearance on the coast of India, it would appear that the numbers taking part in these migrations vary.

The visiting sharks are more numerous in certain years than in others.

The records of their world distribution further indicate, that these sharks, in the course of their migrations, follow the coast lines, or take advantage of chains of islands. They are not fish which roam the open seas. All records are from coastal or confined waters. It is significant that they have never been encountered in the mid ocean steamer lanes, which criss-cross the oceans of the world, where these great surface swimming fishes would not have failed to have been observed at some time or other. Gudger (1940) has brought together various records of the ramming of whale sharks by ships at sea. All these records are from coastal waters or from confined or archipellagian seas.

The fact of these seasonal movements being established, the question arises whether whale sharks, after their journeys in quest of food, return to the places from which they came. We know that whale sharks, after a temporary appearance in our coastal waters, disappear from our coasts during the disturbed conditions of the south-west monsoon. Do they spend this period of their absence roving the stormy seas? The suggestion seems unlikely, in the case of a coast hugging fish, which selects the sheltered waters of island seas for a permanent habitat. On the other hand, does this period of absence from our shore coincide with their breeding time and do these sharks return to their spawning grounds? If so, where do they breed? We know them to be permanently resident only in certain archipelagoes. Not only are they most numerous in such areas but they have been seen assembled there in great schools. Two such assemblages have been recorded from the East Indian Archipelago—one, off the coast of Papua; the other was seen, in the month of September, in the Straits of Buton. Schools have been observed also in the Philippine Archipelago. The basking shark, which, is a kin to the whale shark in most of its habits, at certain times assembles in schools of 60 to 100. Norman (loc. cit.) suggests that these assemblages may be associated with breeding. Unfortunately, we know nothing about the breeding of the whale shark or of the basking shark. The young of these fishes have never been taken. But it is safe to assume that these archipelagoes, where these sharks are most numerous, and where they are found throughout the year, are also their breeding grounds. Wanderings for food followed by assemblages for spawning is not an uncommon habit among fishes. Many species of fish with circumscribed breeding areas, after temporary wanderings for food-getting, return to their breeding grounds to spawn, and it is probable that whale sharks belong to this class and return to their spawning grounds. Gudger in discussing the place of origin of the whale shark and the mode of its dispersal, indicates the Philippine Archipelago as the centre from which the species originated—the centre from which, with the aid of favourable currents, it has extended its range and permanently established itself in various parts of the world. It would appear that this dispersal was brought about, in the first instance, by the circumscribed area of the breeding habitat and the need for finding food and space for an increasing

population, and, that wanderings, associated with food getting initiated and brought about this dispersal. The fish in the course of their wanderings established themselves wherever suitable conditions of life prevailed, i.e., in other archipelagoes. These archipelagoes in their turn became centres of productive distribution from which, at appropriate seasons and aided by suitable currents, whale sharks wander for food returning whence they came for purpose of spawning.

Local Names.

The many local names for the whale shark indicate that the fish is well known on the west coast of India and in Ceylon. In the following list an attempt has been made to give the derivation and meaning of the names used.

Sind. *Mhor.* The name *mhor* is an Arabic word meaning 'stamp' or 'seal'. Its application to the whale shark probably has reference to the spots or 'stamp-like' markings which ornament its head and body.

Bombay. *Karanj* (Marathi). Derived from Sanscrit *karanga* meaning a tree. The name is also applied in Bombay to the tree *Pongamia glabra.,* whose seeds produce a medicinal oil. I am not able to suggest a reason for the application of this name to the whale shark. Local fishermen use oil extracted from the liver of the shark for medicinal purposes. The name may have some such significance.

Bhariat (Marathi). *Bhari*: meaning great or big.

Travancore Coast. *Pulli-udoombu* (Tamil). Mr. Poduval, Curator of the Trivandrum Museum, says that the term means 'spotted reptile'; *pulli* meaning spotted; while the term *udoombu* is commonly applied to the Monitor Lizard (*Varanus*) and may have been suggested by the 'lizard-like' shape of the head.

Makara shiravu (Malayalam). Mr. Narayan Rao, Superintendent of Fisheries, Travancore, tells me that this is the most common name for this fish in Travancore. His explanation of the derivation of the term is interesting, as it provides confirmation of the seasonal migrations of these sharks to the Malabar Coast. *Makara* is the 6th month of the Malabar Era, which corresponds more or less to a period commencing with the middle of January and ending with the middle of February in the Roman Calendar. *Shiravu* means shark. Interpreted, the name would be 'January-February' shark. The period of occurrence sometimes provides the local name for a fish. On the Norwegian coast, the Piked-Whale or Lesser Rorqual (*Balaenoptera acutirostra*) is called the 'Summer Whale' because it appears more frequently during that season.

Osman Shira (Moplah). Poduval states in a letter that this is also one of the names by which the fish is known in Travancore. It is used by the Moplah fishermen.

Ceylon. *Muni-muthu-mora* (Singhalese). *Muni* means 'corpse' and *muthu* = pearl, and *mora* = shark; translated, the name would mean 'corpse-like-pearl-spotted shark'. 'Corpse-like' from the whale shark's habit of floating on the water, while 'pearl-spotted' has reference to the markings.

Photo by *Felicitas Studio*

Whale Shark landed at Chowpatty Beach, Bombay City, 16th January 1940. Close up view of head.

Frontal view of the 18ft. Whale Shark landed at Bombay, 16th January [illegible]. Note the enormous gape. The width of the mouth is 2ft. 8 ins.

Description.

Smith's (1849) description fully covers the external appearance of the fish. Certain details may be amplified. Reference should be made to the marked concavity of the inter-orbital space (Plate VI). It is this concavity which masks the flat wedge-shaped form of the head giving it when seen or photographed in profile a deceptive fusiform appearance. The nasal flaps are well developed and extend in a crescentic fold from the nostril to under the rim of the lip (Plate VII).

Body keels. Smith's description is as follows:—

'Sides of body irregular from two distinct longitudinal keels which commence together a little in front and considerably above the extremity of the first branchiae, and recede a little from each other as they proceed backward: of these the lowermost pursues a waved direction and at last is lost or coalesces with the keel on each side of the caudal fin. The upper again pursues a more direct course, becomes forked posteriorly, and both its branches terminate under and anterior to the dorsal fin'.

In Smith's plate of *Rhineodon typicus* (Plate 26, Illustrations of South African Zoology) the two lateral keels are well shown and the bifurcation of the upper keel is illustrated. In both specimens I had the opportunity of examining in Bombay, 3 distinct keels were present on either side of the body. A dorso-lateral keel, commencing above the branchiae and extending to below the second dorsal, and a median keel commencing anterior to the first dorsal and extending to the region of the tail. The third, the lowest keel, is the strongest and most pronounced. It commences behind the last gill-slit and reaches to the tail, coalescing there with the keels on its axis. Apparently, there is some variation in the disposition of keels. The three keels may remain distinct, or the upper and median keel may coalesce anteriorly, as in Smith's South African example.

Claspers. Both specimens stranded in Bombay were males. In the larger of the two specimens (21′ 6″) the claspers are well developed and extend backwards as far as the hind edge of the ventral. In the second specimen, a smaller shark (18′ 7″) the claspers fall short of the posterior edge of the ventrals and correspond in this respect with the description by Mulle and Henle (1841) of the 15′ example exhibited in the Paris Museum.

Colouration.

Such observations as have been made on the colouration of whale sharks reveal a certain variation, understandable in a fish of so wide a range. The data are too meagre to connect such variation with geographical distribution. But in reading the notes on colouration one is struck by the fact that in all the examples from the Central and Eastern Pacific and the Atlantic the prevailing tone of the upper surface of the body is described by various observers as brown or some shade of *brown*. This colouration is noted in examples from Cape Inubo, Japan (Kishinouye 1901), the Gulf of Panama (G. Chierchia 1884), the Gulf of California

(Gill, 1902) and in examples from Florida Bay (Gudger 1915) and Bean (1902). On the other hand, in colour descriptions of specimens taken in the Indian Ocean the prevailing tone of the dorsal surface ranges from deep *bluish-grey* to *lavender purple*. This was the colouring of the specimen taken at the Cape of Good Hope (Smith 1849), and of the example taken at the mouth of the Hoogly, Bay of Bengal (Lloyd 1908). A deep purplish blue was again the colour of the two specimens which I examined in Bombay. The colour of the dorsal surface of the Bombay specimen agreed with Smith's description of the Cape of Good Hope example. The under surface of the body in both Bombay specimens was 'dead white'—not 'reddish white'. The same flush of red or pink, which Smith noted, appeared under the head and on the margins of the fins. The dorsal surface and the head were covered with a profusion of white spots. On the body, these spots are arranged in a regular series of vertical rows. In the Bombay specimens, there were 27 of these rows. In each alternate row, the spots are fainter and tend to coalesce into linear markings (*vide* Plate I), so that, as a whole, the markings tend to present a pattern of rows of large, well spaced spots, alternating with linear bands. The anterior dorsal fin was spotted and faintly marked with transverse lines produced by a coalescing of spots. Second dorsal, without spots. Pectorals profusely and caudals sparsely spotted. The presence of these markings provide a further indication of the shore haunting habits of this fish, markings of this nature being, as a rule, absent from species which live in the open sea.

Size.

The largest specimen obtained so far on the Indian coasts measured 29 ft. and the smallest about 13 ft. Mr. Poduval, Curator of the Trivandrum Museum, informs me that captures of still smaller specimens are quite familiar to the fishermen. The whale shark is known to attain a length of 60′, this being the dimension of a specimen captured on the east coast of the Gulf of Siam (Smith 1925). All examples taken or stranded on our coasts are then, far from full-grown. The probable explanation is that the smaller sharks enter the shallower waters where they are more likely to be caught or stranded—most of the records from our coasts are the result of captures by fishermen, and fishing in our waters is largely limited to a zone a few miles from the coast. Such large specimens as have been observed on our coasts have been observed from ships at sea. There is the 40′ specimen, which was run down by a steamer off the Ceylon coast and Captain Foley's observation of a monster, 'as big as a whale' which was seen from a ship approaching Madras. The larger whale sharks avoiding the shallower inshore waters run less risk of capture in fishing nets or of stranding.

I give below detailed measurements of the two examples taken at Bombay, and include measurements recorded by other writers of whale sharks taken on our coasts.

Table of Measurements.

Detailed Measurements of Whale Sharks Taken on the Coasts of India

——	Prater. Bombay 1940	Prater. Bombay 1939	Thurston. Madras 1894	Hailey. Ceylon 1883
Body	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.
Length over all	18 7	21 6	22 0	23 9
Girth behind pectorals... ...	8 7	...	...	13 0
Mouth to base of 1st dorsal ...	8 2	9 6	9 10	10 0
Distance between 1st and 2nd dorsal	1 8	2 2	2 3	2 8
2nd dorsal to root of caudal ...	1 10	2 4	...	..
Fins				
First dorsal, anterior edge ...	1 7½	1 9½	1 10	1 10
,, base	1 9	1 10	2 0	...
,, height	1 4½	1 5	...	...
Second dorsal, anterior edge ...	0 10½	0 11	0 11	0 11
,, base	0 10	0 11	...	...
Pectoral, anterior edge... ...	3 1½	3 5	3 2	3 6
,, base	2 2	1 10	1 8	...
Ventrals, anterior edge ...	0 10	1 0	...	1 0
,, base	1 3	1 3	...	...
Anal, anterior edge	0 8	0 8	...	0 9
,, base	0 6	0 6	...	0 9
Caudal, upper lobe	5 0	5 0	5 0	5 0
,, lower lobe	2 8	2 8	2 6	2 7
Head				
Width of mouth	2 8	2 8	2 6	2 7
Width between nostrils ...	1 9	2 1	...	...
Width of head 1 ft. in front of 1st gill-slit	4 4	4 6	...	...
Diameter of eye	0 1½	0 1½	0 1½	0 1¼
,, spiracle	0 1½	0 1½	...	...
Distance, eye to tip of snout ...	0 6½	0 10	0 10	...
Tip of snout to 1st gill-slit ...	2 10½	3 3	3 4	...
Gill-slits				
Length of 1st gill-slit	1 7	1 8	1 11	...
,, 2nd ,, ...	1 10	1 11	1 11½	2 7
,, 3rd ,, ...	1 9	1 9	1 9	...
,, 4th ,, ...	1 8	1 8	1 8	...
,, 5th ,, ...	1 6	1 7	1 7	...

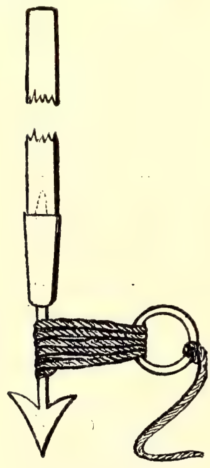
Remoras or Sucker Fishes and Whale Sharks.

Remoras or sucker fishes are commonly known to attach themselves to sharks and other marine animals, or even to floating objects. They do not attach themselves solely to the external surface

of the fish but are often found in the mouth or under the gill covers. With the whale shark the interior of the mouth is a common place of attachment. The whale shark landed at Sassoon dock, Bombay, had a Sucker-Fish (*Remora remora*) cleaving to its palate, well inside the mouth. Several of these fishes escaped from the mouth of the second Bombay specimen as it was being beached. Chiercha also records the finding of several remoras adhering to the inside of the mouth of a whale shark taken in the Gulf of Panama. The whale sharks' habit of feeding open mouthed give the remoras an opportunity of freely leaving and returning to their cavernous perch. In his account of the ramming of a whale shark off the coast of Ceylon (p. 259) the skipper speaks of 'several large fish (seemingly dog-fish), about a cubit in length, which were gamboling about the monster entering the mouth at pleasure and returning to it again'. His 'dog-fish' were obviously remoras, which in their association with whale sharks obtain comfortable carriage to feeding grounds where there is always an abundance of small fish to prey upon. That they sometimes pay for their temerity in selecting the mouth of the giant as a place of attachment is shown in Kishinouye's finding of a remora in the stomach of a whale shark taken off the coast of Japan. The fish was probably inadvertently swallowed by its 'host'.

Harpooning and Capture of Whale Sharks in Indian Coastal Waters.

Dr. Buist (1850) gives an account of the harpooning of whale sharks at Karachi. He published an illustration of the type of harpoon used, which is reproduced here. He states that the fish, once struck, is allowed to run till tired out and beaten with a club till stunned. The following is Lt. J. L. Heisch's account of the two whale sharks harpooned by him at Karachi in March and April 1936:—



Line, 600 fathoms
cane shaft, 8 ft.
iron shaft, 1 ft. 6 ins.
Barb 5 ins.

'The waters of Karachi have some reputation for the large fish they contain, and encouraged by tales of rays and sharks of considerable size, which were said to come up and bask on the surface, Capt. Heygate of the Royal West Kent regiment and myself decided to see if it was possible to harpoon them. We arranged to hire a *bundar* boat for two days. It was captained by a venerable gentleman with a grey beard, who persuaded us that he had harpooned very large fish for very many years. He was assisted ably by five *adonis*. We succeeded in reducing the crew to five with some difficulty, the old man being anxious to take more, since, as he said 'Big shark very dangerous'. We felt however that he was merely trying to impress, and two *sahibs*, one bearer and six fishermen, seemed more than enough for comfort in a boat so small. We had no experience of the type of tackle we should need, but the fishermen produced two large iron harpoons, which, with their heavy wooden handles, looked as if they would pierce and hold anything. These were laid out in the bows with a large quantity of stout rope attached. We had planned to start at 2 a.m. on 27th of March and try to reach Cape Monze, some 20 miles north of

Karachi, in time to spend most of the day looking for big fish. Cape Monze is said to be one of the best grounds to find them. As it happened we did not finally get away until about 6-30 a.m. owing to the roughness of the sea, which forced us to put back on our first attempt. When we did start, it was still rough, and by no means comfortable in our small boat. Another disadvantage was the difficulty of spotting the fish. The sea went down by degrees, much to the relief of our bearer who had retired to the side and stayed there, after heroically preparing breakfast. By noon, with the stiff breeze blowing, Karachi looked very far away. Upto this time we had seen nothing except a whale blowing some distance away. A little later we saw a large bat-ray jump, an amazing sight, for though it was too far away to estimate its size, it must have been jumping ten feet clear of the water, and made a tremendous splash on landing. Nothing had appeared for us to harpoon, however, and we began to realise that our chances of meeting a shark or a ray basking were rather less than we had supposed. We accordingly made for a fishing ground some four miles off the coast and about 12 miles north of Karachi. Here we somewhat ignominiously let down our lines and caught small fish with inordinate pleasure. We gave this up at about 3 p.m., and sailed towards the coast with the intention of camping for the night. The sea was now quite smooth, and porpoises were to be seen playing between us and the land, which was about 2 miles away. When we were within 200 yards of them, this peaceful scene was disturbed by a shout by our look-out man up the mast. The rest of the crew were on to the target at about the same time, for all at once everyone was shouting and rushing about the boat. The *sahibs*, however, perhaps less experienced in marine matters, sat in simple dignity and waited to be told what it was all about. Suddenly we saw bearing down upon us two fins, about 12 feet apart the forward one hardly visible, and the rear one rising to a sharp point a foot or so above the water. It was plain that the impossible had happened and we had met a shark. Moreover a big one as far as could be seen, and one that slept peacefully on the surface. The shark was now about fifty yards to our right front, and moving very slowly across our path. Meanwhile the old captain, looking less venerable and very fierce, had stationed himself in the bows with a harpoon, while the crew stood by to lower sail if we succeeded. As we bore down on the fish, the atmosphere became electric. It seemed that it must take alarm and dive too soon. But fortunately this shark was blessed with an almost infinite capacity for sleep, and in another moment would have bumped our bows with its head. However, when he was about a yard from the boat, and heading straight for it, our old man plunged the harpoon in just behind the head, and since the fish was so close, put his weight behind it. It took a good half hour to dig that harpoon out. Now the shark woke up with a vengeance. Out went the rope and down came the sail. The rope ran out quickly to about fifty yards, and was made fast. For about 15 minutes he put up a grand fight, swimming deep, and he towed our 20 feet boat with ease. When he wanted to go somewhere, he went, and we went too in no uncertain manner. Once he came to the surface with a terrific struggle, leaping nearly clear of the water and beating up a foam with his tail. He was bleeding freely, and seemed to be much larger than the tiger and hammer-head sharks found in these waters. After this effort there was less struggle, and he became a dead weight. Little by little, with the combined effort of the crew, the rope was pulled in with no active resistance, until we could see the huge bulk beneath the boat. We got a distinct shock when we looked over the side for it was only a foot or two shorter, and the tail looked formidable. It was a handsome brute in the water, with a dark skin and white green spots. We could now see its head which looked square, and its body seemed broader than that of the common shark. In fact it looked odd, but we were not disposed to grumble. We pulled him in a little closer, and put in another harpoon. The shark then broke surface just by the boat, beating the water with its tail. This moment had its excitement, as the size of the brute made its struggles seem more dangerous than they were. It was at its last gasp however, and soon the fishermen were able to administer the *coup de grâce* with long knives. We lashed our catch to the side of the boat, and towed it in to shore, where we dragged the body as far up the beach as we could. It was impossible to pull it right out of the water, but we were able to take our first photograph. Most

unfortunately the camera jammed while the fight was in process. The head was spade-shaped with the eyes set right forward on the extreme corner. Opening the mouth was like lifting the lid of a box. There were no teeth deserving the name, but rows of very tiny ones of the roughness of coarse sandpaper but sharper to the touch. The skin was also very rough when rubbed the wrong way, quite smooth with the grain. It was dark and spotted with white. There were two dorsal fins, both comparatively small and rounded at the point. Ridges parallel with the curve of the back extend along either side of the body, giving it, for all its bulk, a streamlined effect. The tail fin is vertical when the fish swims and the top half in this case was about three feet in length, the lower half much smaller. It is the point of this fin which is most easily visible when the fish is basking. Two powerful flippers are situated just behind the gills on each side. The length of the shark from tip to tail was 18 ft. We eventually took it back to Karachi and hoisted it on a crane. The weight was then estimated at about two tons. Unfortunately we had no idea at the time that this was a whale shark, and rare in these waters, and allowed the fishermen to take the carcase away. They can sell the oil and get, I believe, about Rs. 20 for it. They do not see these fish often enough to make a trade. Sometimes they see one a year, sometimes none. We were more fortunate, for strangely enough on our next trip a few weeks later, we harpooned a similar type of shark, about 3 miles off Karachi. We were in a larger boat and could not approach closer than 10 feet or so. The harpoon had to be thrown this time and later proved insecure. We spotted the fish by the tail fin again, and had a good view of it on the surface and swimming just beneath the boat. We could see the same spotted skin and spade-shaped head. This time we had a short but spirited performance. We were towed for 10 minutes in a very rough sea, and twice our 40 foot fishing boat was turned completely round. However, the constant jerking with the rise and fall of the bows eventually worked the harpoon free. One is naturally cautious in estimating the size of any fish that gets away. I think one could safely say that it was not smaller than the first, and seemed more powerful. The best times of day to find these fish, and others which come up to bask, are between 5 a.m. and 10 a.m., and again from 3 p.m. to 6 p.m. On both occasions all our fun started at 3-30 p.m. There are a large number of ray about if one can find them. We had a shot at one smallish one, about 4 feet across, but the harpoon missed. It is an amusing game, this harpooning, and one fight per trip, makes it worthwhile. We feel though, that ours is a fine example of beginners' luck.'

The methods employed in hunting the great basking shark (*Cetorhinus*) off the coast of Ireland are very similar. For the benefit of those interested in the hunting of these monster sharks Couch's graphic description of the harpooning of the basking shark (Norman, 1937) is published below:—

'The boat . . . approaches the fish with a man in the bow ready to harpoon it; the line attached to the harpoon is 200 fathoms long, and is coiled up in the bow; a man stands by with a hatchet, ready to cut it, should it get entangled or foul of anything in running out. When the fish is struck, he will at the first dart carry out from 70 to 150 or 200 fathoms of line; he makes this rush to the bottom, where he rolls himself, and rubs his wound against the ground to free himself from the harpoon. The fishermen generally allow him an hour to tire himself before they begin to haul upon the harpoon line; they coil up the slack of it again, ready for him to make another rush, and play him in this way, sometimes for eight or nine hours, before they can get him to come to surface; and when he does so they are ready to strike him with two or three more harpoons; and when these are fixed in him, they are able to pull him alongside the vessel with the harpoon lines; they then stretch him fore and aft along the vessel's side, and get a jowl rope round his head, and the bight of a hawser round his tail; they then give him two deep cuts, one one each side of the tail with a hatchet. In his agony and his efforts to get free, he works his tail so hard, that he snaps

the bone across where the cuts were made; they then cut flesh holes in the body of the fish on both sides, that will take a large rope through them; they then reeve ropes through these holes, and by hauling taut on the side of the fish next the vessel, and slacking away rope to the other side of the fish, it will cant him over on his back. They then split down the stomach, take out the liver, which is the only part they use for oil, and let the rest of the fish go adrift.'

'. . . . These fish are most powerful in the water, and if harpooned in the shoulder they are very hard to kill, often carrying off the whole harpoon line; but experienced harpooners strike them in the body near the dornal fin, rather low down, where it will go through into the intestines, or near the vertebrae towards the tail. They must be struck with great caution, as they will stave in the boat with a blow of their tail, if it is at all within their reach'.

Captures of whale sharks on our coasts result commonly from these monster fishes fouling the fishing nets. Mr. S. R. Kaka gives the following account of the capture of the specimen presented by him to the Prince of Wales Museum:—

'My sailing boat, with a crew of six fishermen, which I am running on experimental fishing, left Bombay for deep sea fishing, but due to a heavy storm on the 7th instant (Feb. 1938) they were forced to take refuge at Alibaugh. Whilst returning on the 12th, they halted at a place about 15 miles from Bombay and on finding the depth of water to be 11 fathoms, they cast the nets for fish. Here they encountered the thrilling incident. When the men tried to haul up the net in the noon, they found it impossible due to tremendous weight of the monster which had got entangled within. As it felt the net being drawn, the monster started moving in the opposite direction, and here a tug-of-war between the men and monster ensued. Towards evening, after a desperate struggle lasting some hours, the men, succeeded in drawing the shark close to the boat and captured it alive by fastening slip knots with ropes round its neck and tail and so tied it up alongside the boat. They then sailed for Bombay and arrived at Sassoon Dock on the 13th morning. The shark, however, died *en route* just a few hours before landing, and it required sixty men to haule up to the shore.'

From what has been written it will be seen that the whale shark is a peculiarly inoffensive creature. Its only reaction to attack is the effort to escape, and any danger in hunting these sharks could only arise from the struggles of the animal to get away. Like the basking shark, the whale shark is apparently indifferent to the approach of a boat thus offering every opportunity for the effective placement of the harpoon.

Summary.

Whale sharks visit the coastal waters of India between January and April, attracted by the abundance of zoo-plankton in these waters during this time of the year. Their occurrence mainly on the West Coast of India and Ceylon cannot be explained by a general shoreward movement from the surrounding seas. It is due to the directional movements of surface currents in the Bay of Bengal and the Arabian Sea at this period. Coming with the inflow of water from the Pacific, which sets in through the Straits of Sumatra with the establishment of the north-east monsoon, whale sharks follow the north-east monsoon drift, which flowing across the lower reaches of the Bay of Bengal, brings

them to the south of Ceylon. From thence their journey along the west coast of Ceylon and India is aided by northward flowing coastal currents. Their comparative rarity on the East Coast of India and Ceylon is explained by the absence of favourable currents. The waters which converge upon the Coromandel Coast come from the head waters of the Bay of Bengal and not from the Straits of Sumatra, through which the whale sharks enter Indian seas. The whale sharks which visit our coast *via* the Straits of Sumatra probably come to us from the East Indian Archipelago, where they are known to be permanently resident. Similar seasonal migrations of whale sharks take place from the Philippine Archipelago to the seas off Cape Inubo, Japan, aided in this instance by the north-eastward flow of the Kuro Sivo current. It is proposed that the various archipelagoes in the Pacific, Indian and Atlantic Oceans, where whale sharks are permanently established, are centres from which numbers of these sharks, following the drift of favourable currents, migrate at appropriate seasons into areas where peak periods of plankton productivity provide them with an abundance of food; their appearance in these areas of nominal distribution being more regular wherever plankton productivity is more definitely seasonal. The archipelagoes, where alone whale sharks are known to be permanently resident, are breeding grounds to which these fishes return after their wanderings. A limited breeding habitat has impelled the spread of the species through the three Oceans, the sharks following the drift of warm surface currents in search of food, have established themselves wherever suitable conditions prevailed. The newly acquired places of permanent habitat became in their turn centres of productive distribution from which the geographical range of the fish has been extended.

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SOME COMMON INDIAN HERBS WITH NOTES ON THEIR ANATOMICAL CHARACTERS.

BY

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(*With two plates*).

(*Continued from page* 163 *of Vol.* xlii, *No.* 1).

VI.—LOCHNERA PUSILLA K. Schum.

(APOCYNACEAE).

SYNONYMY AND SYSTEMATIC DESCRIPTION.

Lochnera pusilla K. Schum. in Engl. & Prantl, Pflanzenf. V. 4, Pt. 2 (1895) p. 145; Cooke. Fl. Pres. Bomb. V. II, Pt. I, 129; Gamble. Fl. Pres. Madras, Pt. V, 809; Syn: *Vinca pusilla* Murr.; H.F.B.I., V. III, 640; Dalz. & Gibs. Bomb. Fl., 144; Trim. Fl. Ceyl. V. III, 130; Watt. Dict. Econ. Prod. Ind. V. IV, Pt. 4, 243. *Vinca parviflora* Retz.; Roxb. Fl. Ind. II, 1. *Catharanthus pusillus* G. Don, Gen. Syst. V. IV, 95.

A much-branched annual herb, branches spreading from the base, stem and branches quadrangular. Leaves $1\frac{1}{2}$-3 in. long, opposite, lanceolate, acute, glabrous, membranous, margins rough; axillary glands long, subulate. Flowers small, white, mostly solitary, axillary, on short stalks. Calyx-segments 5, lanceolate-subulate. Corolla salver-shaped; tube slender, inflated above the stamens; mouth constricted, hairy; lobes 5, oblong-obovate. Stamens 5, on the corolla-tube; anthers elliptic or ovate-lanceolate, acute. Pollen grains furrowed, rectangular when dry, and spherical when moistened. Disk replaced by two linear glands. Carpels 2, free; ovules numerous, 2-seriate; style filiform; stigma capitate, with a reflexed hyaline frill at base, and a minute 2-lobed apiculus. Fruit of two slender divergent, striate follicles $1\frac{1}{2}$-2 in. long. Seeds numerous, small, oblong, with many muriculate ribs (Plate I). Flowers Aug.—Nov. Mayuranathan (7) mentions the flowering season as Nov.-March, which is rather unusual for other parts of India. Medicinal (Kirtikar, 6).

INDIAN NAMES.

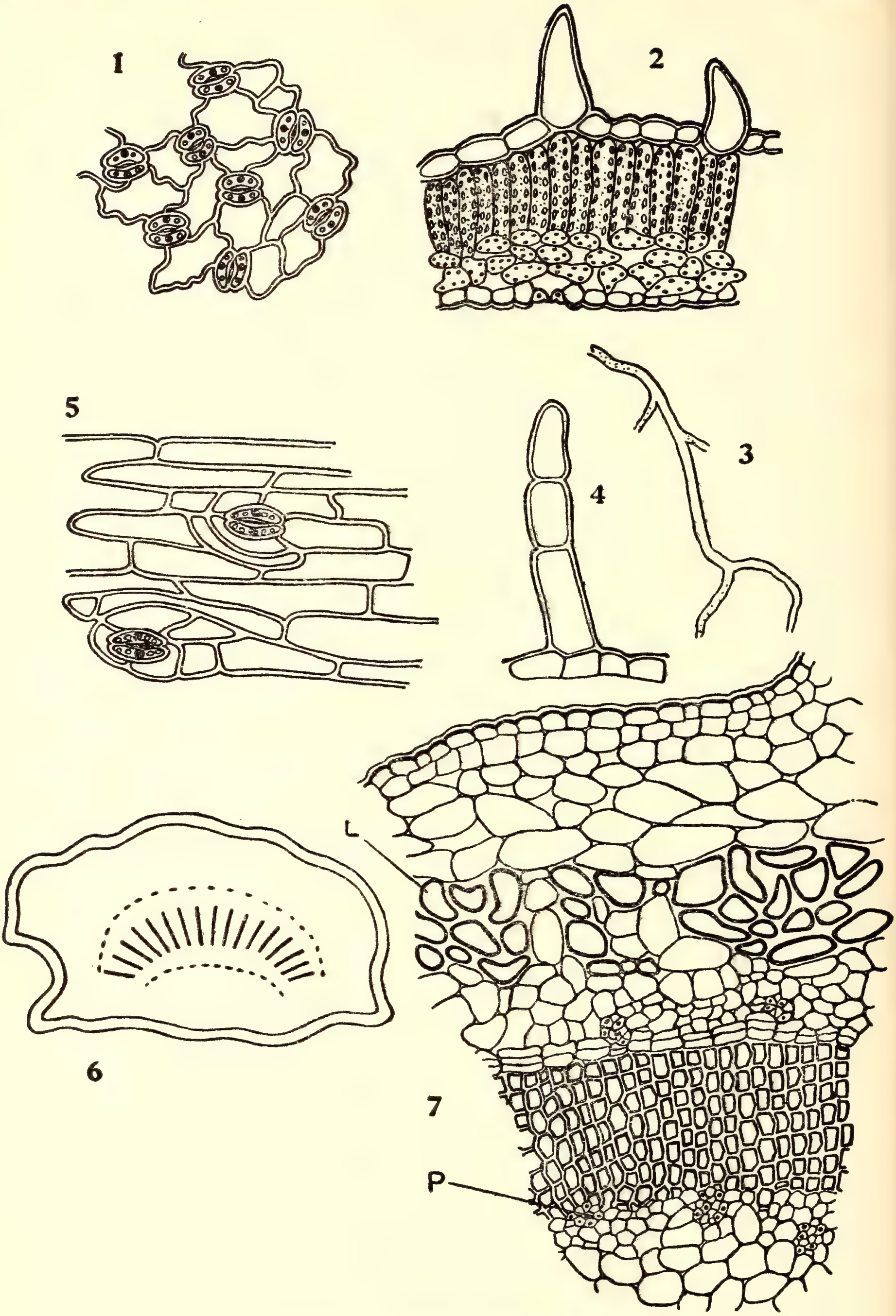
Sanghaphuli, Sankaphi, Sangkhi (*Sans.*); Kapavila (*Malayalam*).

HABITAT.

Common in Deccan (Dalz. & Gibson, 3). Poona, Gujarat (Cooke, 1). Plains Districts of the Circars, Deccan and Carnatic, up to 2,000 ft., a common weed, more scarce on W. Coast (Gamble, 5).

Sayeedud-Din—*Lochnera pusilla* K. Schum.

For explanation see end of article.



Sayeedud-Din—*Lochnera pusilla* K. Schum.

For explanation see end of article.

A weed of cultivated ground (Mayuranathan, 7). A common weed in the beginning of the rainy season (Sayeedud-Din, 8).

Distribution: India (W. Himalaya, Upper Gangetic Plain; W. Peninsula); Ceylon.

Anatomical Notes.

Structure of the leaf. (Plate II, Figs. 1 & 2). The leaf-structure is bifacial. Stomata occur on both the sides, but are much more numerous on the lower side. They are surrounded by two or more ordinary epidermal cells, and lie in a level with the epidermis. The epidermal cells on the upper side are larger than on the lower. These observations conform to those recorded by Solereder (9) in other species. No special features have been observed in the mesophyll, viz., gelatinization of the cell-walls of the spongy tissue or sclerosed palisade cells.

Oxalate of lime occurs in the form of ordinary solitary crystals.

The hairy covering (Plate II, Figs. 2 & 3) consists of simple unicellular and uniseriate hairs. Some are very small, resembling papillae. Glandular hairs are absent.

In the stem non-articulated thick-walled laticiferous tubes are found in abundance mostly in the cortical region (Plate II, Fig. 7), but in the leaf they occur in the veins, and run freely in the mesophyll, as in *Vinca major* (Solereder, 9). The thick-walled tubes by taking up a faint colour of safranin are apt to create some confusion, but chemical reactions show that the walls are composed of cellulose. The contents do not show any reaction for starch.

Structure of the petiole and stem (Plate II, Figs. 4-6). The petiole contains a single arc-shaped bicollateral bundle. Stomata which occur in the furrows are accompanied by two or more subsidiary cells parallel to the pore, that is they are of the Rubiaceous type. The epidermis of the ridges is composed of thick-walled cells. The cortex is composed of chlorenchyma and collenchyma, and as will be naturally expected the latter is more confined to the ridges. Intraxylary phloem is present in the form of isolated bundles at the margin of the pith.

Conclusions.

The chief features revealed by the study of this plant are characteristic of the family Apocynaceae to which it belongs. As it is closely allied to Asclepiadaceae many features are in common. The following is a brief summary of the characteristic features of *Lochnera pusilla*:

1. In the leaf the stomata are surrounded by ordinary epidermal cells, but in the stem they are surrounded by two or more subsidiary cells parallel to the pore, thus revealing the Rubiaceous type of stomatal apparatus.

2. Oxalate of lime occurs in the stem as well as in the leaves in the form of solitary crystals.

3. The hairy covering consists of simple unicellular and uniseriate hairs.

4. Occurrence of non-articulated thick-walled laticiferous tubes.

5. The petiole contains a single, bicollateral arc-shaped bundle. In the stem intraxylary phloem is present in the form of isolated bundles at the margin of the pith.

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Explanation of Plates.

Lochnera pusilla K. Schum.

Plate I.

Fig. 1.—Black and white drawing of *Lochnera pusilla* K. Schum. (Nat. size).
Fig. 2.—Corolla opened out. (×10).
Fig. 3.—Pistil with calyx attached. (×10).
Fig. 4.—Pollen grain in dry condition. (×40).
Fig. 5.—Pollen grain, moistened. (×40),

Plate II.

Fig. 1.—Leaf-epidermis, showing stomata surrounded by ordinary epidermal cells. (×215).
Fig. 2.—T. S. Leaf, showing two unicellular hairs on the upper epidermis, a stoma on the lower epidermis, palisade and spongy tissue. (×215).
Fig. 3.—A latex-tube from the leaf. (×215).
Fig. 4.—An uniseriate hair from leaf-epidermis. (×215).
Fig. 5.—Stem-epidermis, showing stomata surrounded by subsidiary cells. (×215).
Fig. 6.—T. S. Petiole, showing an arc-shaped vascular bundle, diagrammatic. (×50).
Fig. 7.—T. S. Stem. L. laticiferous tubes in cortex; P. intraxylary phloem in groups. (×215).

(*To be continued*).

THE EARLY STAGES OF INDIAN LEPIDOPTERA.

BY

D. G. SEVASTOPULO, F.R.E.S.

PART VI.

(*Continued from page 44 of this volume*).

RHOPALOCERA.

SATYRIDAE.

Mycalesis visala Moore, *visala*

Moore, *Lep. Ind.*, i, 189, pl. 64, figs. 1, 1a-1i. 1890-92.

Ovum spherical, the base slightly flattened, pearly white, minutely punctate. Deposited 6-viii-40. Hatched 9-viii-40.

Newly hatched larva white, the head black. Head with a short tooth projecting subdorsally. Anal somite ending in two short processes. A few hairs. After feeding the body becomes green and later a dark crimson dorsal stripe appears on the posterior third of the body, this stripe broadens considerably on the anal somite and extends along the anal processes. Moulted 12-viii-40.

2nd instar—Similar. The cephalic and anal processes proportionately rather larger. Under a lens there is a faint yellowish white subdorsal line and the dorsum is sprinkled with minute yellow dots. Moulted 14-viii-40.

3rd instar—Similar. Moulted 16-viii-40.

4th instar—Head blackish brown, the backs of the processes dull greenish. Body dull green, shagreened with minute yellowish white dots. A dark dorsal stripe, becoming dull crimson on the 10th somite and continuing up the anal processes. A pale subdorsal and sublateral line. Legs and prolegs green. Head and body finely pubescent. Moulted 19-viii-40.

Final instar—Head blackish brown, the backs of the processes dull pinkish buff, and with four brownish spots frontally forming a semicircle. Body pinkish buff, granular and finely pubescent. A dark dorsal stripe, without any trace of crimson. A yellowish subdorsal stripe, edged below with darker, and a yellowish sublateral stripe. A series of oblique dark stripes arising subdorsally and ending in the lateral area. 1st pair of legs blackish brown, the others and the prolegs pinkish buff. Anal processes and venter pinkish buff. As the larva ages, the colour darkens to purplish brown, the markings remaining unchanged. Immediately before pupation the markings fade and the larva becomes a bright green. Pupated 24-viii-40.

There is probably a green form of larva also, but I have not bred it.

Pupa bright apple green in colour. 2nd to 5th abdominal somites with paired subdorsal yellow dots. A subtornal yellow dot

on the wing case. Under a lens, the abdomen with very minute yellow speckling. Head straight in front. Thorax slightly keeled. Wing cases slightly dilated across the dorsum. Cremaster long and pinkish in colour. A female emerged 30-viii-40.

Food-plant—Grasses.

Described from larvae bred from ova from a Calcutta caught female.

LYCAENIDAE.

Tarucus nara Koll.

Head pale brown, retractile and very small. Body flattened and with the lateral edge slightly scalloped by the intersegmental divisions. Ground colour very pale green, in some cases more or less tinged with purplish. A white dorsal stripe beginning from the 2nd somite, and sometimes edged, either wholly or partly, with crimson, and sometimes with a central crimson line, which may be confined to the first few somites or extend the whole length of the dorsal stripe. The green forms with a subdorsal pattern formed of four white specks on each somite, the purple with a subdorsal series of single crimson dots. A lateral line, white in the green forms, crimson in the purple. Body densely covered with minute white granules and white pubescence. Legs and prolegs green. Venter green, even in the purple forms. Ant gland and tubercles not prominent.

Ants do not seem necessary to the larva's wellbeing as, although thickly attended when found, some lived for a week before pupation without their attentions.

Pupa on a thin carpet of white silk and supported by a girdle. Of the usual Lycaenid shape. Colour yellowish green, the wing cases less tinged with yellow, and more or less speckled and shaded with black, some pupae having no more than a dorsal and spiracular series of black specks, whilst others are almost completely black shaded.

Food-plant—*Zizyphus Jujuba*. The larva feeds on the undersurface of the leaf, leaving a semi-transparent track about an eighth of an inch wide.

Described from a number of full-fed larvae found in Calcutta 24-x-40, one of which pupated 26-x-40 and a male emerged 2-xi-40.

Bingham quotes de Niceville's description of the larva of *T. theophrastus* F., of which species *nara* was previously considered a subspecies, which tallies substantially with mine He adds that the ants attending the larvae have been identified by Dr. A. Forel as *Camponotus rubripes* Drury (*sylvaticus* Fabr., subspecies *compressus* Fabr.) and *Phidole latinoda* Roger.

Zizeeria trochilus Freyer, *putli* Koll.

Bingham, *Fauna Brit. Ind.*, Butterflies, ii, 366. 1907.

Head black, small and retractile. The usual woodlouse-shaped Lycaenid larva with the segments rather deeply cut. Colour bright grass green with a darker green dorsal stripe edged with paler and a white sublateral line. A series of very faint oblique pale lines subdorsally. Body thickly covered with white pubescence. Ant gland and tubercles small and inconspicuous.

Ants do not seem essential to the larva's development as mine lived for ten days without their attentions and pupated successfully.

Pupa formed on a leaf of the food-plant on a carpet of white silk and supported by a girdle. Green with a darker dorsal stripe along the abdomen. Thorax domed. The anal end rounded and slightly flattened. With the exception of the wing cases, densely clothed with longish white hair.

Food-plant—*Rhynchosia minima* DC. (Leguminosae).

Described from a full-fed larva found in Calcutta 12-x-40, pupated 15-x-40, and a male emerged 19-x-40.

Bingham, quoting de Niceville, writes:—'Larva when full-grown a little over a quarter of an inch in length, onisciform as usual; the head very small, black and shining, entirely hidden when at rest, being covered by the second segment; the colour of the body grass-green, with a dark green dorsal line from the third to the twelfth segment; two subdorsal series of short parallel streaks, each pair being divided from the next by the segmental constriction, these streaks paler than the ground colour; an almost pure white lateral line below the spiracles, which is the most conspicuous of all the markings; the segmental constrictions rather deep; the whole surface of the body shagreened, being covered with very small whitish tubercles, from which spring very short colourless hairs. Dr. George King, Superintendent of the Royal Botanical Gardens, Sibpur, near Calcutta, has identified its food-plant as *Heliotropium strigosum*, Willd. Professor A. Forel identified the ant as *Pheidole quadrispinosa*, Jerdon. Pupa about three-sixteenths of an inch in length, pale green, of the usual Lycaenid shape, densely covered everywhere, except on the wing-cases with somewhat long white hairs.'

HETEROCERA.

Syntomidae.

Syntomis passalis F.

Ovum white, unsculptured, spherical with the base slightly flattened. Laid in a large batch but with the individual ova not touching each other. Deposited 24-viii-40. Hatched 29-viii-40.

Larva with the head bright reddish chestnut, rather small. Ground colour of the body deep blackish purple. Each somite with a transverse series of six rosettes of short blackish-grey spinous hair, arising from blackish warts. Legs bright reddish chestnut. Prolegs purple.

Pupa in a slight cocoon of brown silk interwoven with a few of the larval hairs; the bulk of the hairs, however, are not shed and remain attached to the cast skin. Dark reddish brown, the abdominal somites with a central ring of conjoined black spots. Wing cases black with the veins red-brown. Leg cases red-brown streaked with black. Antenna cases red-brown but unstreaked. Apex of the abdomen blunt and densely clothed with hooked golden-brown hairs.

Food-plant—Dahlia and Orange Cosmos,

Described from a number of full-fed larvae bred from ova from a Calcutta caught female, one of which pupated 8-x-40 and a male emerged 16-x-40.

ARCTIIDAE.

Amsacta lineola F.

Ovum creamy white, spherical with the base slightly flattened. Minutely punctate. Laid in fairly large batches, the ova touching each other. Hatched on the fourth day.

Larva with the head honey brown, the clypeus filled in with smoky black and with a smoky black stripe outlining it. Body with a broad black dorsal stripe with a median pale line on the thoracic somites. The lateral area brownish grey. Hair fairly short, that on the dorsum black and arising from a double dorsal series of small and a subdorsal series of larger dull blackish blue warts; on the lateral area grey and arising from a lateral and sublateral series of greyish warts. Spiracles white and set in a broad pinkish ring. Venter blackish. Prolegs honey brown. Legs blackish.

Food-plant—Orange Cosmos.

Described from a full-fed larva bred from ova deposited by a Calcutta caught female in August 1940. The larva died when preparing for pupation.

LYMANTRIIDAE.

Laelia exclamationis Koll.

Butlr., *Ill. Het.*, vii, 123, pl. 138, fig. 6. 1889.

Hamps., *Fauna Brit. Ind.*. Moths, i, 442. 1892.

Head dull brownish, the clypeus filled in with blackish. Ground colour of body blackish, a pale brownish subdorsal stripe, the sub-spiracular area greyish brown. Densely clad with brownish grey hairs arising from a subdorsal, supra- and sub-spiracular, and sublateral series of greyish brown warts. 4th to 7th somites each with a dense dorsal brush of silky hairs, dark brown in colour but appearing an almost silvery brown in certain lights. 11th somite with a similar dorsal brush. Legs pale brown. Venter and prolegs greyish brown. Spiracles white.

Pupa in a cocoon of brown silk mixed with larval hair. Wing, leg and antenna cases bright chestnut brown, the thorax and dorsum darker, the ventral surface of the abdomen paler. Thorax and first five abdominal somites with scar-like dorsal ridges of a pale brown granular appearance.

Food-plant—Coarse grasses.

Described from a full-fed larva found in Calcutta 2-x-40, spun 4-x-40, and a male emerged 14-x-40.

Hampson's description is 'Larva brown, with tufts of long grey and brown hair; dorsal tuft of short brown hair on 3rd to 6th somites; a subdorsal series of very short orange tufts, three to each somite; a lateral pale line.' Butler writes 'Larva blackish: head pale buff; two dorsal stripes of contiguous yellow and red spots interrupted on each segment by a whity-brown spot or tubercle bearing long hairs, on the fifth to eighth segments these

tubercles are very large, prominent and woolly, and bear long hairs; those on the thirteenth segment are not prominent, but bear long tapering pencils of hair; the tenth and eleventh segments bear a small central dorsal carmine tubercle; an imperfect rose-pink stripe bearing tubercles of the same colour emitting pale brown hairs; a broad lateral rose-pink band, on and below which are small tubercles bearing white hairs; ventral surface yellow, streaked in front and at the sides with black; legs shining vermilion-red. Length of preserved larva 28 millim.' The figure appears to have been drawn from a blown larva.

NOTODONTIDAE.

Turnaca acuta Wlk.

Ovum spherical, chalky white freckled with ochreous. Micropyle a dark spot. Laid in small batches or in twos and threes.

1st instar larva—Head yellowish brown. Body green with three dark brown lateral lines. Head and body with sparse black hairs. Shape rather broad anteriorly, tapering towards the rear.

Ova laid by a female in Calcutta 6-viii-40, hatched 11-viii-40. The female refused to lay until a bamboo leaf was put in the box. In spite of Seitz' suggestion that the larvae feed on Monocotyledons, they refused various species of grasses, bamboos and palms and died without feeding.

LIMACODIDAE.

Thosea loesa Moore.

Hamps., *Fauna Brit. Ind.*, Moths, i, 379. 1892.

Hering Seitz, *Indo-Austr. Bombyces*, x, 712.

Head green, marked with brown round the jaws, retractile. 1st. somite retractile. Shape oval and flattened. Colour bright grass green. A narrow white dorsal stripe, edged with an interrupted dark blue line and running through a pink spot on the 7th somite. A series of eight subdorsal red spots. A subdorsal series of nine tufts consisting of four or five very short green bristles. A lateral series of eleven scoli, increasing in size from front to rear, first and second very short, crimson with black bristles and directed forwards, third to ninth longer, green tipped with pink and with green bristles and pointing sideways, tenth and eleventh similar but directed backwards.

Cocoon almost spherical, slightly longer than broad. Dark brown in colour veined with lighter, of the usual hard Limacodid type. One cocoon was almost black. Empty pupa skin yellowish brown.

Food-plant—Areca Palm.

Described from a full-fed larva found in Calcutta 6-x-40, spun 9-x-40, and a male emerged 4-xi-40.

Hampson's description, which is given under the name *sinensis*, is as follows:—'Yellow or green, with a white or yellow dorsal stripe, sometimes with a red spot at middle, subdorsal and sublateral series of spinous tubercles reddish towards tips. Cocoon purplish grey.' Seitz gives substantially the same description and adds that the larva lives on a great number of cultivated plants.

Altha nivea Wlk.

Head retractile, pale greenish marked round the jaws with brown. 1st somite retractile and edged with black anteriorly. Body pale green, a paler narrow dorsal and subdorsal stripe, a similar lateral stripe and one between it and the subdorsal. A yellow sublateral stripe defining the ventral area. Body oval, highly convex, without visible segmentation. The skin translucent in appearance and slightly granular in texture but without hairs or tubercles. The markings appear to be well below the surface of the skin and vary in intensity with the angle from which the larva is viewed. Spiracles round, yellow with a yellow ring.

Cocoon hard, compact, chocolate brown in colour and flecked with buff specks, particularly towards the front. These specks are white when the cocoon is newly spun. Shape round, slightly longer than broad. Empty pupa skin yellowish brown in colour.

Food-plant—*Tinospora cordifolia* Miers (Menispermaceae).

Described from a full-fed larva found in Calcutta 21-viii-40, spun 23-viii-40, and a female emerged 9-ix-40.

PSYCHIDAE.

Amatissa cuprea Moore.

Brahmachari, *Journ. Bomb. Nat. Hist. Soc.*, xl, 56. 1938.

Head dark brown, streaked and speckled with paler. First three somites dark brown, mottled with paler, and with a dorsal, subdorsal and sublateral pale stripe. Abdominal somites very slightly chitinised and pinkish grey in colour. A whitish lateral line. Anal claspers and flap more heavily chitinised and yellow brown in colour. Abdominal prolegs very small. Legs brown marked with paler and increasing in size from 1st to 3rd pair.

Male pupa reddish brown, rather slender. The abdominal somites with the posterior edge rather wider than the anterior edge of the somite following and forming a ridge round it. 10th to 12th somites each with a transverse spined ridge posteriorly. End of the abdomen turned under and the cremaster consisting of two short cone-shaped processes each ending in a sharp point. Female pupa rather paler in colour, the usual type of chitinised maggot without leg, antenna or wing cases, broader behind and tapering anteriorly.

Case cylindrical, tapering from mouth to apex, and made of greyish silk covered with minute fragments of vegetable matter. Larger pieces of leaf and twig are also attached, these are fixed by the upper end, the lower hanging loose. Before pupation a slender peduncle, about a quarter of an inch long, is spun fixing the case to a leaf or twig. As usual, the imago emerges from the bottom of the case.

Food-plant—Found on *Ipomoea palmata*, but fed readily on *Lagerstroemia indica*. Brahmachari records it as a pest on Banana in Southern India.

Described from a larva and pupae from cases found in Calcutta 28-ix-40, from another of which a male emerged 5-x-40.

Brahmachari describes the larva as having the head and thoracic somites grey in colour with patches of brown, the abdomen

of darker hue. He gives a figure of the male pupa, but does not shew the expanded abdominal rings nor the spinous ridges and makes no mention of them in the text.

NOCTUIDAE.

Beara dichromella Wlk.

Moore, *Lep. Ceyl.*, ii, 116. 1882-83.

Head reddish brown, marked with darker above. 1st to 3rd somites with the dorsum greyish white with a longitudinal and transverse black lines. 4th somite with the dorsum black with a crescent-shaped yellow mark. 5th somite with a black dorsal hump. 6th to 10th somites with a broad creamy yellow dorsal stripe with a purplish black median line. 11th somite with a black dorsal hump edged on each side and posteriorly with orange. 12th and 13th somites orange yellow. The lateral area black with two indistinct and broken yellowish lines. A broken orange sublateral stripe from 2nd to 10th somite. Sparse white hairs arising from white specks. Spiracles black ringed with white. Venter greyish green. Legs and prolegs greyish green.

Cocoon of papery yellow silk. Supported by a short stalk spun about two-thirds from the front of the cocoon. Canoe-shaped, the front sloping backwards and slightly ridged and rising into a backward pointing curved projection. A small point about the middle and the posterior end terminating in a small double point. The imago escapes through a slit in front.

Food-plant—*Zizyphus Jujuba.*

Described from a full-fed larva found in Calcutta 28-x-40, spun 30-x-40 and a female emerged 6-xi-40.

Moore's description is as follows:—'Larva pale purple, with a purple-red dorsal tubercle on sixth and another on twelfth segment; anterior segments with minute black-bordered white tubercular spots, and two lateral rows of similar spots on all the segments, from each of these and the dorsal tubercles project short fine whitish hairs; a dorsal yellow band from anterior to posterior tubercle. Cocoon pale purplish-red, attached by a silken peduncle to a leaf or twig, truncated and with a conical projection at one end. Feeds on *Celtis orientalis.*'

Chalciope hyppasia Cr.

Ovum spherical, olive green speckled with rusty red. The micropyle sunken and with sculptured ridges running from micropyle to base. Laid singly. Hatched on the third day.

Newly hatched larva very long and slender. 1st and 2nd pairs of abdominal prolegs absent. Resting position and mode of progression very Geometer-like. Head yellowish brown, body brownish green.

Half-grown larva with the ground colour greenish and three lateral purple brown lines. Venter with a dark median stripe and two purple brown lines on either side.

Full-grown larva—Head with the central portion yellowish with three purple brown lines, a semi-circular olive brown patch striped with yellowish on either side. Ground colour of the body pale yellow with the following longitudinal stripes composed of

minute dots—a dorsal lavender line in continuation of the central dark line of the head, a dark violet brown subdorsal stripe with an internal lavender line in continuation of the inner edge of the dark lateral patch of the head, a dark violet brown lateral stripe with a double lavender line between it and the subdorsal stripe,—and with a clearer yellow stripe containing a double rust-red line below it. 11th and 12th somites each with a black subdorsal dot. Venter sprinkled with minute reddish brown dots, a dark median stripe and indications of two slightly darker stripes on either side. Spiracles black. Legs yellow brown. Prolegs like the body.

Pupa in a slight cocoon of white silk spun among leaves. Pale purplish brown and covered with a white bloom. Apex of abdomen blunt with a ring of short teeth round it and ending in a few hooked spines.

Food-plant—*Rhynchosia minima* DC. (Leguminosae).

Described from a full-fed larva, bred from ova from a Calcutta caught female, 20-x-40, pupated 25-x-40, and a male emerged 3-xi-40.

Ophideres fullonica L.

Moore, *Trans. Zool. Soc.*, xi, 64, pl. 12, figs. 1, 1a.

Hamps., *Fauna Brit. Ind.*, Moths, ii, 560. 1894.

2nd instar—Head and body black. A white lateral streak on the 9th and 10th somites. Resting attitude with the legs and prolegs gripping close together and the body between looped, the hinder part held erect.

The ocelli on the 5th and 6th somites are indicated in the 3rd instar by orange red crescents. The rest of the adult markings developing in the 4th and 5th instars.

Full-grown larva—Head velvety black. Ground colour of body velvety black. Sublateral area sprinkled with minute white dots, which join into an irregular streak from the 5th somite backwards. 1st somite with a subdorsal line of minute white dots. 2nd somite with a pair of minute bright blue subdorsal specks anteriorly and a transverse median line of six similar specks. 3rd somite with a median transverse line of six bright blue specks. 4th somite with a divided creamy white lateral blotch with three minute blue specks above and three below arranged in the form of a triangle. 5th and 6th somites each with a black lateral ocellus surrounded by a wide ring, creamy white above and orange red below, and containing a bright blue spot as pupil. Two minute blue specks above and two below each ocellus. A deep maroon subdorsal stripe with a black central stripe, starting on the 5th somite in some larvae and on the 6th in others and extending to the anal flap. 7th to 10th somites each with a subdorsal triangle of minute blue specks and with two similar specks in front of each spiracle. 9th and 10th somites with an irregular and very broken creamy white lateral blotch. 10th and 11th somites with a creamy white sublateral streak in continuation of the sublateral speckling. 11th somite rising into a short cone dorsally, the apex maroon and interrupting the black ground colour

between the maroon subdorsal stripes, and with a creamy white stripe along the sides. Two bright blue dorsal dots in front of and one on each side of the maroon apex. 12th somite with three lateral and one subdorsal bright blue speck and marked with creamy white posteriorly. Spiracles orange red and set in bright maroon patches that increase in size from front to rear. Legs black banded with maroon. Prolegs black with the apex maroon, the 1st pair partially aborted, 2nd pair dotted externally with creamy white, 3rd and 4th pairs with a creamy white stripe. Venter black, some specimens with a double maroon median stripe.

Pupa in a cocoon of thin white silk spun between leaves. Dark purple mahogany, coarsely punctate and very highly polished. The apex of the abdomen with the cuticle wrinkled longitudinally and the cremaster consisting of four longish hooked spines with four shorter ones round them.

Food-plant—*Tinospora cordifolia* Miers (Menispermaceae).

Described from a full-fed larva found in Calcutta 24-viii-40, pupated 27-viii-40, and a male emerged 4-ix-40.

Hampson's description, which is presumably based on Moore's but makes no mention of the fact, is as follows:—'11th somite dilated and surmounted by a tubercle; colour dark purplish brown, the dorsum brown from 6th to 11th somites; legs red; spiracular scarlet patches largest posteriorly and with some irregular white markings round them, on somite 9 in the form of an oblique white bar; a yellow subdorsal mark on 4th somite; black ocelli with yellow iris and white pupils on 5th and 6th somites, and two yellow patches on 11th somite.'

Argadesa materna L.

Ovum spherical, the base flattened. Pale yellow green without sculpturing and very small for the size of the insect. Laid singly or in twos and threes on the food-plant.

1st instar—Head brownish green. 1st somite with a brownish green dorsal plate. Body yellowish green and rather oily in appearance. A few short black hairs. 1st pair of prolegs completely aborted. Resting attitude with the true legs and abdominal prolegs gripping, the forepart of the body between them looped and the posterior portion held erect.

2nd instar—Head and body blackish brown. 2nd to 6th somites each with a pair of orange red lateral specks and a subdorsal orange red speck on each somite from 4th to 6th.

The adult markings develop in the subsequent instars.

Full-grown larva—Head black. Ground colour of body blackish brown. A double dorsal and double subdorsal red brown line, the latter interrupted by the ocelli on somites 5 and 6. 1st somite with two black-ringed bright blue dots at the base of the leg, an anterior lateral and posterior subdorsal black-ringed blue dot. 2nd and 3rd somites each with a pair of black-ringed blue dots subdorsally in front and a transverse series of six similar dots centrally. 4th somite with a sublateral and subdorsal triangle of three black-ringed blue dots. 2nd to 4th somites each with a double orange red sublateral speck. 4th somite with an orange red subdorsal

spot. 4th and 5th somites with a small cream-coloured dorsal spot. 5th and 6th somites with a lateral ocellus; this consists of a black spot, the lower part of which contains a blue crescent-shaped mark edged above with reddish, and which is surrounded by a broad ring, the upper anterior quarter creamy white, the rest orange red, and the whole ringed with black. Sublateral area speckled with white. Two black-ringed blue dots above and two below each ocellus. 7th to 10th somites each with a subdorsal and sublateral triangle of three black-ringed blue dots. A subdorsal line of whitish specks backwards from the 7th somite. 10th and 11th somites each with a cream-coloured dorsal spot. 11th somite rising into a cone, with a double yellowish pink blotch on each side and marked with cream behind, a black-ringed blue dot on either side of the apex and two more in front. 12th somite with a lateral triangle of black-ringed blue dots, a dorsal and subdorsal yellowish pink blotch with a black-ringed blue dot between them. Spiracles black. Legs and prolegs blackish brown, the 1st pair of prolegs completely aborted. Venter black brown with a dark median stripe, edged on each side with paler, and expanding into a black spot between each pair of prolegs, and with a dark stripe separating the ventral and sublateral areas. 2nd and 3rd somites with a pair of black-ringed blue dots in front of each leg, and 3rd to 5th and 9th with a submedian triangle of three similar dots, 10th and 11th somites also with similar markings but the apical dot very much separated from the two basal.

Another form is very similar in markings but with the ground colour velvety black and without the double dorsal and subdorsal lines. 11th and 12th somites with the markings cream instead of yellowish pink.

A third form has the head clay brown. The ground colour of the body clay brown with a darker dorsal stripe. The ocelli brownish purple with an indistinct pinkish crescent-shaped mark for pupil and surrounded by a double black ring, the upper quarter between the rings crimson, edged above and below with white, the other three quarters purplish brown. 7th to 11th somites with a dark subdorsal stripe with a central line of whitish dots. The sublateral area from the 5th somite backwards pinkish instead of speckled with white. Other markings similar to the first form.

Pupa in a thin cocoon of white silk spun between leaves. Rich mahogany brown, minutely punctate and very highly polished. The intersegmental areas of the abdomen darker. The spiracles almost black. The apex of the abdomen with the cuticle wrinkled into a honeycomb pattern and with the cremaster consisting of two longish hooked spines with a very short hooked spine on either side.

Food-plant—*Tinospora cordifolia* Miers (Menispermaceae).

Described from a number of full-fed larvae found in Calcutta 24-viii-40, one of which pupated 27-viii-40 and a female emerged 4-ix-40.

Hyblaea puera Cr.

Moore, *Lep. Ceyl.*, iii, 81, pl. 154, fig. 2a. 1884-87.

Hamps., *Fauna Brit. Indi.*, Moths, ii, 372. 1894.

Head smooth, bright reddish chestnut. 1st somite with a chestnut dorsal plate with a white median line through it. A broad golden fulvous dorsal stripe with a white median line and edged on each side with white. A broad whitish lateral line, the area between it and the subdorsal line golden fulvous with a large quadrate black spot on the forepart of each somite, the thoracic somites with this area almost entirely black. 4th to 11th somites each with a white-ringed black dot posteriorly immediately below the subdorsal line. 11th somite with a transverse yellowish white stripe between the subdorsal lines. 12th somite with a similar, but narrower, stripe with two black dots immediately in front of it. 13th somite with the anal plate yellowish brown with black dots. The area below the lateral line greenish yellow with two yellow lines. Venter greenish yellow. Legs pale chestnut brown. Prolegs yellowish green. Spiracles pale brown ringed with black. A few hairs. Lives in a spun together leaf and ejects a brownish fluid from the mouth when disturbed.

Pupa in a folded leaf lined with white silk. Rather slender, bright reddish chestnut. The cremaster fairly long and ending in a bunch of hooked spines, which are attached to the silk of the cocoon.

Described from a full-fed larva found in Calcutta 18-viii-40; pupated 20-viii-40 and a male emerged 26-viii-40.

Moore's description is 'Larva with a few short silky hairs; dark purplish grey above, olive-green below; with dorsal and lateral white lines, a subdorsal row of minute white dots and rings; a row of black dots on lateral line; head and second segment, and front legs black. Pupa dark purple-brown. Feeds on Bignoniaceae.' His plate shews a larva with the upper half deep violet and the lower yellow green. Hampson's description is based on that of Moore.

GEOMETRIDAE.

Petelia medardaria Herr.-Schaff.

Moore, *Lep. Ceyl.*, iii, 396, pl. 193, fig. 2b. 1884-87.

Head yellowish green, marked at the sides and on the vertex with brown. Ground colour of body bright green. A pinkish buff subdorsal stripe and an indistinct triple yellowish dorsal line. Spiracles red. Legs yellowish brown. Prolegs green, the feet reddish brown. Venter green frosted with white. Turns purple before pupation.

Pupa subterranean. Dark olive green in colour, the ventral surface of the abdomen slightly tinged with yellow. Cremaster a single stout spike, ending in several hooked spines.

Food-plant—*Zizyphus Jujuba*.

Described from a full-fed larva found in Calcutta 24-x-40, buried itself 27-x-40, and a female emerged 3-xi-40.

Moore gives the following description:—'Larva with 10 legs; smooth; purplish red, with slender longitudinal black lines; spiracles white. Pupa red, greenish in front, segments ringed with yellow.'

Scopula emissaria Wlk., *emissaria*.

Head slightly flattened in front, pale greenish brown with a paler sub-median stripe. Body yellowish green with a darker green dorsal stripe. Thoracic somites with an indistinct subdorsal and lateral whitish stripe. Spiracles black. Legs and prolegs greenish. Shape very long and slender, broadening slightly posteriorly. Resting attitude straight, but when alarmed the anterior portion of the body is coiled up.

Pupa in a slight web spun, in captivity, among litter. Slender, bright green with a slightly darker green dorsal stripe along the abdomen. Spiracles dark chestnut. Cremaster and last somite chestnut brown, the cremaster consisting of a bunch of hooked spines.

Food-plant—*Aeschynomene indica* Linn. (Leguminosae).

Described from a full-fed larva found in Calcutta 4-viii-40, pupated 6-viii-40, and a female emerged 10-viii-40.

(To be continued.)

PHOTOGRAPHING IN CEYLON'S BIRD SANCTUARIES.

BY

W. W. A. PHILLIPS, F.L.S., F.Z.S.

(*With 6 plates*).

For the better protection of the bird-life of the Island of Ceylon, a number of areas have been proclaimed, during the past few years, as sanctuaries—wherein no animal life, other than fish, may be wantonly destroyed or disturbed. Most of these areas are either brackish lagoons, near the sea coast, or large artificial irrigation reservoirs, commonly called 'tanks', scattered about the dry-zone provinces. All of them teem with bird-life, large and small, and all of them are of absorbing interest to the naturalist and to the bird-photographer. To the latter, however, it is the 'tank' sanctuaries that are of the greatest interest, for it is in them that he is able to come to intimate terms with so many of the larger wading birds—the storks, herons, spoonbills, ibises etc. and here too, he can see, at close quarters, that most grotesque and famous bird, the pelican—the Asiatic spotted-billed pelican—soaring with effortless flight far overhead or balancing himself, clumsily, on the top of some lofty tree.

Of all the sanctuaries that I have visited, Giant's Tank, on the Indo-Ceylon Railway, in the north-west of the Island and Kumana, tucked away, far from the beaten track, in the jungles of the south-east, have proved the most interesting and the most productive of good photographic results.

Equipped with several hessian 'hides', a boat and my cameras, I have spent many vastly entertaining days watching the fascinating cavalcades of bird-life that flow, unceasingly, past the well-concealed 'hide', planted in the midst of a common nesting ground of those numerous species that seek the seclusion of flood-girt heroneries in which to raise their families.

At Giant's Tank, one of the largest of our sanctuaries, storks breed earlier than at any other place known to me. By Christmas-time, well-grown young are often in the nests but sometimes, when the rains are late, eggs are still being laid or nest-building is yet taking place at that date. The nests, when built, are congregated together in a large area, of several acres in extent, on flat-topped bushes standing in 4 ft. or so of water, at the end of the enormous tank. From a distance, the bushes are densely dotted with white, as with masses of marvellous white blooms, but, on closer approach, these flower-like dots resolve themselves into a vast concourse of birds, taking their ease on the bush-tops. Egrets, pond-herons and night-herons are on the outer ramparts; the larger species—white-ibises, with their curious, black, scimitar-like beaks; spoonbills, with their shovel-shaped bills; darters, with their long snaky necks; grey herons; purple herons; shags;

cormorants; more egrets and lastly, in the inner-most keep, open-billed storks by the acre, are sitting or standing upon their nests or engaged in their other lawful vocations.

Our arrival causes a diversion. With a roar of wings, vast numbers of birds fly up, to wheel screaming their protests into the unheeding air. The open-billed storks are, however, moderately tame and soon cease to take more than a passing interest in our movements. We erect our 'hides' and leave them in position for the remainder of the day—to return the following morning to take our photographs.

The open-billed storks are the most noteworthy of the birds in this sanctuary. They are large white storks, with black flight feathers like the European storks, and most curious beaks—the mandibles not meeting each other closely, as in self-respecting beaks, but having a wide gap between them for the greater part of their length—caused, it is said, by the constant attrition due to the crushing of the shells of the fresh-water molluscs on which these storks feed. Undoubtedly the gap tends to widen, the older the stork becomes—the nestlings have no signs of it.

Smaller in size but of even greater interest, is the Kumana sanctuary in the remote jungles of the south-east corner of the Island. This sanctuary is a permanent, fresh-water lagoon. Tree-girt, it is surrounded and protected by a dense ring of mangroves and bull-rushes, which effectively screen from view all signs of bird-life until the barrier ring is penetrated.

In this sanctuary, the most notable residents are the pelicans and the handsome painted storks. One would reasonably expect pelicans to nest, swan-like, on islets or in reed-beds or at least on low-growing bushes. But no! they choose the branches of tall trees and sometimes build their nests even as much as 40 or 50 ft. above the water-level. They are weird, grotesque-looking birds but very sociable with their own kin. Dozens of pairs nest in the Kumana Sanctuary, on the tops of the lofty trees. Generally, their stick nests are in small groups of three or four, either balanced in a line along a stout branch or bunched together, touching one another, so that the brooding birds may gossip away the weary hours, discussing the day's topics and the short-comings of their neighbours. Beside them sit their mates, awaiting their turn upon the eggs or lazing away the day till the night-fishing recalls them.

It is amusing to watch a pelican alight on the topmost twig of some high tree; the twig bends, with the unaccustomed weight, and much flapping, with the outstretched wings, and much clutching, with fully webbed feet, is required before steadiness and a well-balanced seat are acquired.

But of all the multitude of birds gathered together, in this small sanctuary, with the common object of propagating their species, the sedate and dignified painted storks are, to me, the most attractive and the most fascinating. Large numbers nest in the trees at the far end of the swamp, amongst or below the pelicans but above the lesser folk—the night-herons, egrets, pond-herons and the little black cormorants. Their nests are

Photo by *W. W. A. Phillips*

Open-bill Storks standing upon their nests.

Photo by *W. W. A. Phillips*

Photo by *W. W. A. Phillips*

The Spoonbill with his shovel-shaped beak.

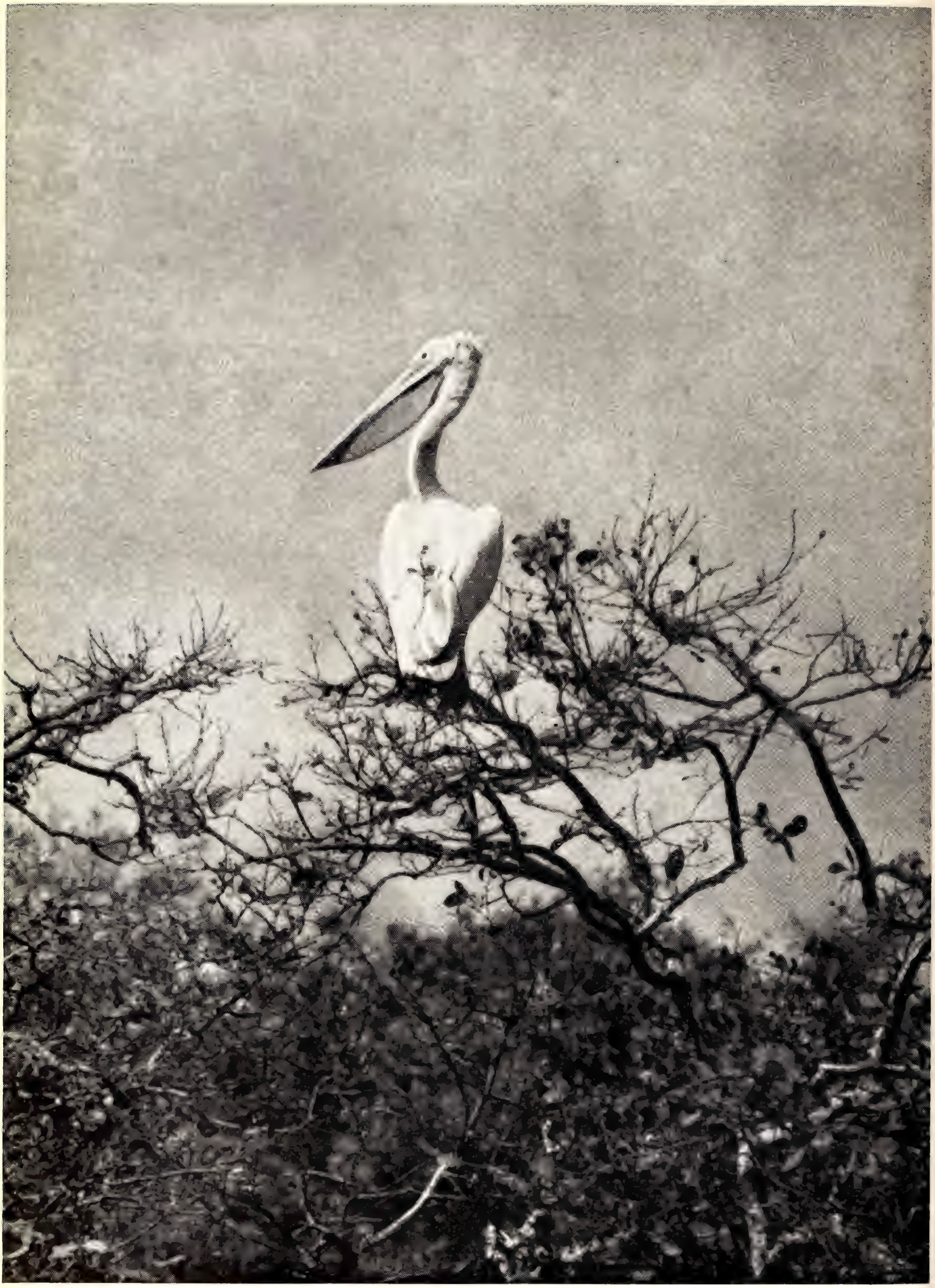

Photo by *W. W. A. Phillips*

Pelican balanced on a tree-top.

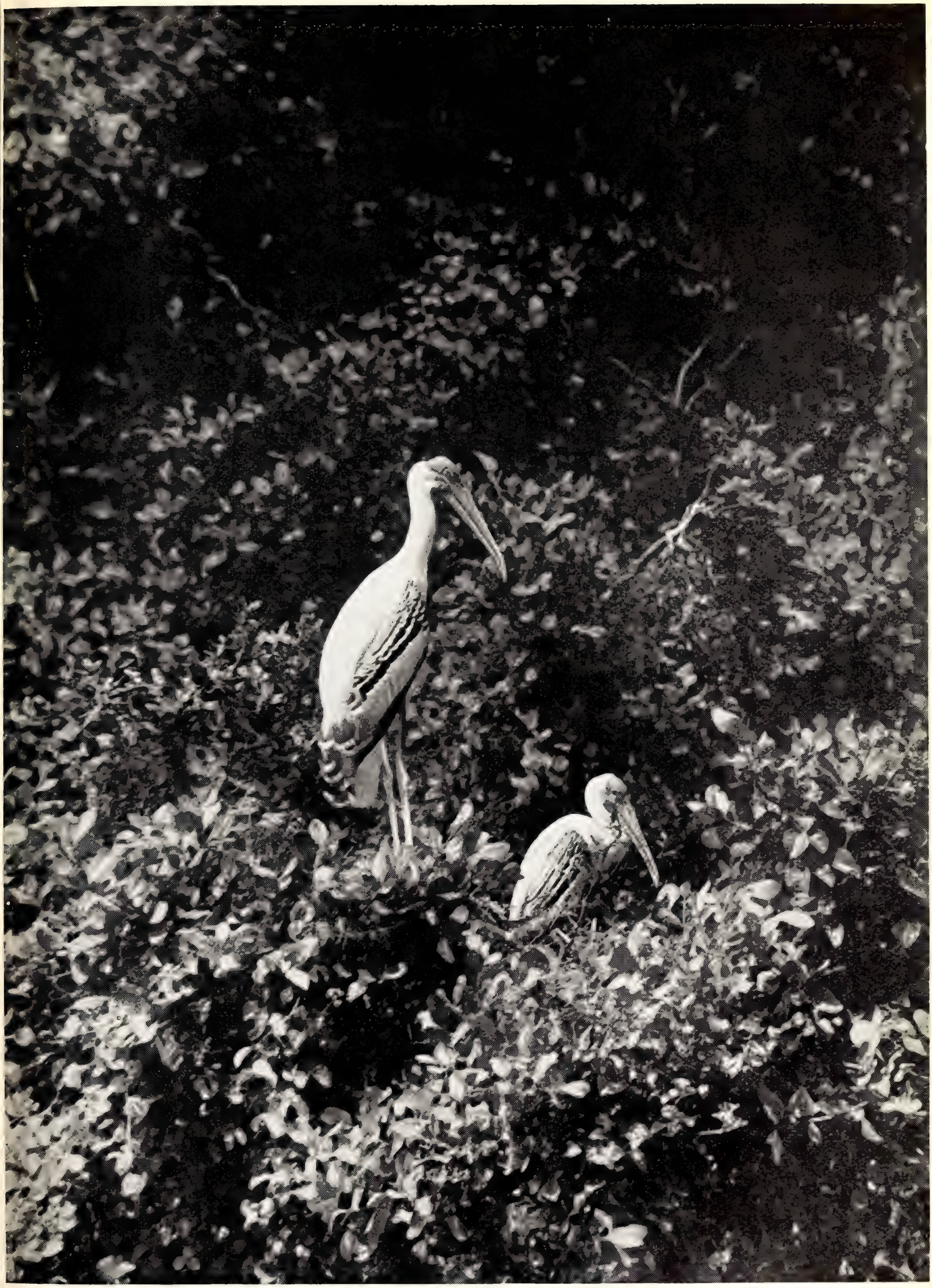

Photo by *W. W. A. Phillips*

'Sedate and dignified Painted Storks.'

Photo by W. W. A. Phillips

ludicrously small for such large birds but evidently they are quite adequate for their purpose. To watch and photograph these handsome storks, from the close proximity of a well-placed 'hide', is a delight. Their colours blend wonderfully—the flamingo-pink of the back plumes and wings fades into the delicate pinkish-white of the upper plumage; the iridescent greenish black of the wing-coverts blends with the glossy black of the flight feathers and tail and these, together with the bright orange of the bill, head and face, make up a colour scheme most pleasing to behold.

During the heat of the day, these storks rise up from brooding their eggs and stand, with wings outstretched and bills half open, panting with the heat. In this statuesque posture they remain for five or ten minutes cooling themselves down and, at the same time, shading their eggs or their small young from the direct rays of the burning sun. Also, incidentally, they display themselves to perfection to the unseen watcher.

To bring back permanent records of this wonderful wealth of bird-life, has been one of the principal objects of my visits to these remote sanctuaries. This object has been achieved for, in addition to securing pictures of pelicans and painted storks, photographs of spoonbills, white ibises, greater and lesser egrets, white-necked storks, grey herons and purple herons, pond herons and night herons, cormorants, shags, darters, little cormorants, blue coot and teal have been secured as the birds have sat brooding or feeding their young.

Bird photography is always a fascinating pursuit, whatever the species that is being photographed. But I am inclined to think that, on a short trip, the most satisfying results are to be obtained in our 'tank', sanctuaries where the teeming and varied bird-life gives one so much scope for photographing species after species, all within a few yards of one another. To watch the various individuals engaged, quite unconscious of the photographer's presence, in their own peculiar domestic activities, is a pleasure that never fades.

A CONTRIBUTION TO THE STUDY OF THE BIOLOGY AND PHYSIOLOGICAL ANATOMY OF INDIAN MARSH AND AQUATIC PLANTS.

BY

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(*With two plates*).

INTRODUCTION.

General Remarks.—In the present series of articles the writer has embodied investigations made in the course of his studies on Indian marsh and aquatic plants. The majority of these fall in the category of plants which have been regarded by various botanists as amphibious or semi-aquatic, or as helophytes or marsh plants. It is proposed to put forward in these notes a few facts which will throw some light on the biology and physiological anatomy of the Indian plants belonging to these two important ecological groups; for, with the exception of a recent contribution by Biswas and Calder (4), there seems to be very little information available.

Special attention has been paid to the morphological and anatomical differences induced by growth in water and in air, and to the differences observable in the same plant during its aquatic and land stages. Such a study is not a new one. Several writers such as Costantin (5, 6, 7, 8, 9), Schenck (26, 27), Askenasy (2) and Gluck (17) have proved that the plant is extremely plastic, and that external factors, chiefly the presence or absence of water in the soil or about the plant, can bring about numerous morphological and anatomical changes. Such a comparative study acquires a special significance in the case of the plants described in these pages in view of the fact that in India, as Saxton (24; 25) has pointed out, two different sets of conditions prevail during the year at any given spot, and these constitute two or three entirely different habitats, with the result that in one and the same spot different plants belonging to different ecological groups may thrive at different times of the year. Thus during the first period which starts with the burst of the rains mesophytic plants may flourish; if, at the end of this period the soil becomes water-logged or covered with water, swamp conditions or aquatic conditions prevail giving rise to marsh or aquatic vegetation. After the rains the water rapidly dries up, so that about a month after the end of the monsoons a period of intense drought sets in, and in places which during the rains are either water-logged or under water, a xerophytic vegetation finally establishes itself. The effect of the change of conditions on our waterside plants must therefore

Malachra capitata L.

The plant on the left is grown in water; its stem is swollen and adventitious roots have developed on the submerged portion. The plant on the right, grown as a land plant, has developed normally.

be to induce rapid and profound morphological and anatomical modifications, so that the same plant which at one period has hydrophytic or helophytic adaptations, may in the next period be rapidly transformed into a typical terrestrial plant, or, should the plant survive long through the dry season, into a typical xerophyte.

As far as the writer is aware this aspect of our Indian waterside plants dealing with the morphological and anatomical modifications induced by periodic changes in the environment has received scant attention from Indian botanists. The papers read by the writer before the Botanical Section of the Indian Science Congress in 1926 and 1934 (10, 11, 12, 13, 14, 15) were merely intended to indicate the lines along which further useful work on the subject of marsh and aquatic plants could be pursued. Since then there have appeared two contributions by Mullan (21, 22) on investigations done by him on certain Indian amphibious plants.

Arrangement and Method.—In the course of this work, as it is not always possible to separate the true water plants from marsh plants, the terms aquatic or water plants will be deemed to include also marsh plants. The plants are dealt with family by family. In each family an attempt is made to co-ordinate information regarding the occurrence of its aquatic representatives in the world as well as in India. Then follows a description of the plants which form the special subject matter of our study.

These descriptions are substantiated by observations in the field, experiments conducted in certain cases, and anatomical examination. As far as possible, the whole is illustrated by photographs and diagrams presenting the special morphological or biological features on which stress is laid in the description, and by camera lucida drawings or photomicrographs showing the anatomical structure of the tissues or organs described. The interpretations of the various structures observed and described, as well as the conclusions drawn therefrom, are embodied in the description of each plant. Facts appearing in one description have been restated in another. This seems to be unavoidable, unless other important considerations are sacrificed; such as, for instance, avoiding excessive cross reference.

For purposes of anatomical examination fresh material was for the most part employed and hand sections taken. Such a method was found to be both practicable and convenient. The paraffin method has its drawbacks when employed in the case of plants having large air-spaces, owing to the difficulty of driving away air from the tissues and the resistance offered to the penetration of paraffin to all parts of the tissues. It was also found that in the case of plants living in water, unless a very delicate fixative was employed, plasmolysis of the cells inevitably took place resulting in their shrinkage and the consequent obliteration of the original structure of the tissues. Moreover, the utility and convenience of hand sections is obvious in those cases where it is desirable to trace the development of tissues or to observe the effects of the environment on various parts of the plant. As these changes are very gradual and cover long distances on the stem

or root, they cannot all be detected within the short lengths of tissue employed in the preparation of microtome blocks. For this purpose it is necessary to take serial sections at considerable distances apart, and this is best done by means of hand sections. In a few cases, however, microtome sections gave good results.

DESCRIPTION.

Malvaceae.

The *Malvaceae* include 35 genera, and over 700 species distributed chiefly in the warmer regions of both hemispheres. Of these, only two genera are known to have aquatic representatives, viz. *Althaea* Tourn., a genus of 15 species inhabiting the temperate regions of the Old World, and *Malachra* Linn. consisting of 6 species natives of the warmer regions of America and of the West Indies. Two of these are naturalized in Asia and Africa.

Key to the Genera.

A. Branches of style as many as carpels.
Involucral bracts 6-9, connate at base.
Flowers axillary, solitary or clustered, or arranged in terminal racemes......................................1 *Althaea*

B. Branches of style twice as many as carpels.
Involucral bracts 4, large leafy.
Flowers densely capitate..2 *Malachra*

The genus *Althaea,* so far as our information goes, has only one aquatic representative, viz. *Althaea officinalis* Linn., the Marsh Mallow. This plant occurs in marshes, especially in maritime districts in Europe, extending to England and Ireland and eastwards to India. In America it is said to occur only as an escape. In India it is found wild in Kashmir. As its distribution in this country is limited, and it is more a plant of the temperate regions we will not take it up for special study.

The whole genus *Malachra*, on the other hand is reputed to be aquatic; its members being usually found in marshy places within the tropics. One species, *Malachra capitata* L., is widely distributed in India. It is dealt with in detail below.

Malachra capitata Linn. Syst. ed. 12, II (1767), 458.
=*M. conglomerata* Turcz.
=*M. alceaefolia* Jacq.
=*M. mexicana* Schrad.
=*M. rotundifolia* Schrank.

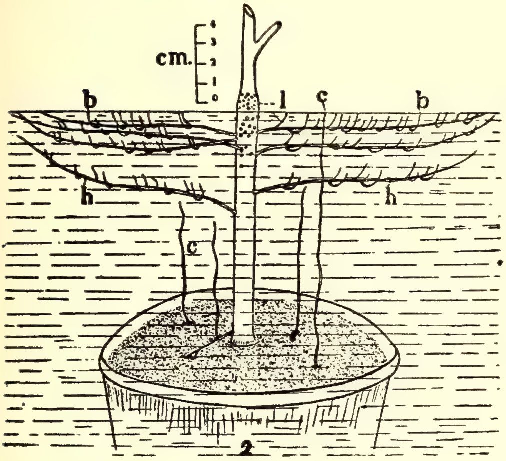
Vernacular Names.—*Bombay*: Ranbhendi; *Marathi*: Ranbhendi; *Porebundar*: Pardeshibhindo,

Malachra capitata L. is a native of Tropical America, cosmopolitan in the tropics. Though not indigenous, the plant is completely naturalized and a weed in many places in India. Judging from the fact that it has not been mentioned by Roxburgh, Wallich or Wight it must be a recent introduction. It is now plentiful throughout the damp tracts of India, and is very common in waste places in Bombay and Salsette, especially by the sides of tanks, pools of water, and rice-fields.

About sixty years ago the plant attracted considerable attention in Bombay as a possible source of fibre that might compete with the Bengal Jute (31). Though the efforts then made to *cultivate* the plant were pronounced a failure, the reports on the *quality* of the samples of fibre obtained from it would justify a fresh interest being evinced in the plant.

The rigid sturdy habit of the plant and its frequent occurrence on soil which is not water-logged would make one least suspect it to have aquatic tendencies. But *Malachra capitata* usually grows on ground that is liable to be inundated in the rains, so that often plants are found standing with their stems partly under water to various depths, and these plants show certain modifications due to the environment.

To determine the influence of the environment two plants of almost the same size were transplanted in pots. In about the middle of July one of



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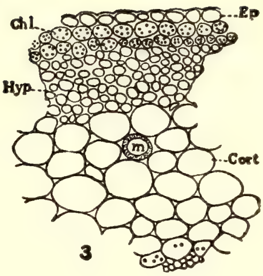

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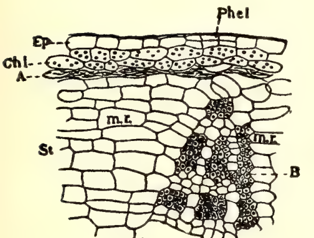

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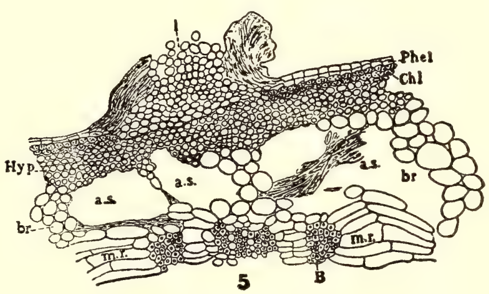

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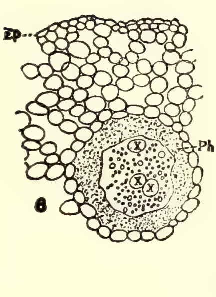

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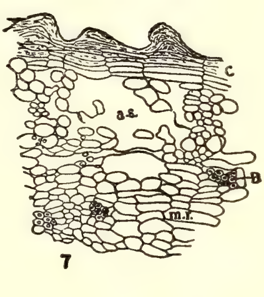

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Malachra capitata L.

For explanation see end of article.

these was immersed to a depth of 15 cm. in a tub of water, while the other was left to grow as a land plant. Two months later the differences between the two plants were recorded and the plants photographed (Plate I, fig. 1). While no change had taken place in the control plant, the plant growing in water showed a number of adaptations which are more clearly represented in diagrammatic form (Plate II, fig. 2).

The stem was swollen up to a little above water level, and the submerged portion was covered with a large number of white lenticels (*l*) which extended to a little above the surface of the water. These lenticels were very strongly developed on the stem just below and above water level, where they showed protruding masses of soft white tissue. In addition to this, long white roots (*h*) spread out horizontally from the submerged portion of the stem into the surrounding water. It was observed in the course of the experiment that the lenticels first made their appearance, and a little later the lateral roots were seen to be given out through the lenticels. A similar sequence of lenticels and roots has been observed in other plants (19). In all such cases it seems obvious that the extraordinary development of lenticels is the first expression of the immersion in water, and the growth of lateral roots a subsequent manifestation thereof. These lateral water roots bore, among others, delicate branches (*b*) which bent upwards towards the surface of the water. The lateral underground roots also sent up erect branches (*c*) which likewise grew up to the water surface. As a matter of fact, in nature, wherever the plant grows in water-logged areas, large numbers of similar roots may be seen peeping out of the soil, and they strongly suggest comparison with the pneumatophores of certain mangroves, like *Avicennia*. This phenomenon of roots being directed upwards is not a case of negative geotropism. It is due rather to their sensitiveness to gases (aerotropism) induced by the air above the soil or, in the case of soil which is completely covered by water, by the more aerated surface layers of the water towards which the roots bend and grow and from which they probably also draw their supplies of oxygen. These roots are therefore, like pneumatophores, respiratory in function. Aeration, no doubt, first takes place through the lenticels, but when the lateral roots are given out these also help in the process. But respiration must not be taken to be the exclusive function of these water roots. Their profuse branching which subsequently takes place in all directions as the result of prolonged submergence and the extremely fine divisions of the rootlets thus produced makes them well adapted also for absorbing nutrient solutions from the surrounding medium; lastly the presence of chlorophyll in some of the older roots points to the photosynthetic role of such roots.

A comparative anatomy of plants growing under ordinary terrestrial and marsh conditions shows differences in their histological structures.

The transverse section of the young stem of a plant growing out of water (Plate II, fig. 3) shows an epidermis (*Ep.*) of more or less tabular cells. The cortex is distinguishable into two parts :—(*a*) an outer zone of small collenchymatous cells (*Hyp*) and (*b*) an inner zone of much larger parenchymatous elements (*Cort*) with triangular spaces between them. Two or three layers (*Chl*) immediately abutting on the epidermis are not collenchymatous and contain chloroplasts. The innermost layer or two of the cortex also contains chloroplasts. Isolated cells (*m*) in the parenchymatous cortex have their cell-walls transformed into mucilage. As regards the vascular ring it need only be mentioned that, as the stem grows older, the portions of the medullary rays lying in the phloem broaden outwards as in the case of other *Malvaceae*. The pith also consists of parenchyma with triangular intercellular spaces. Isolated mucilage cells also occur in the pith. Serial sections of older stems reveal that, while the vascular cylinder is increasing in diameter, the cells of the inner zone of the cortex collapse (becoming at first flattened in a tangential direction) and finally disappear; later on the greater part of the collenchyma also disintegrates in a similar manner; but the two or three sub-epidermal layers which contain chlorophyll grains always persist. Owing to the growth in diameter of the vascular cylinder the latter comes almost into contact with the superficial layers which are expanding less rapidly. As a result the spaces occupied by the intervening cortical cells which have been destroyed become obliterated or reduced to mere crevices which are seen to extend in a tangential direction. In Plate II, fig. 4 the destroyed cells of the cortex are seen as a narrow shaded

band (*A*) between the chlorophyllous sub-epidermal layers (*Chl*) and the stele (*St*). The phellogen (*Phel*) which arises much later in the development of the plant has its origin in the epidermis. In its formation an epidermal cell divides into two cells; the inner of these remains merismatic whilst the outer becomes suberized. In this way a thin band of cork is developed which replaces the epidermis. Apparently no phelloderm is formed.

The transverse section of the submerged portion of the stem of a plant growing in water (Plate II, fig. 5) shows lysegenously formed lacunae (*a.s.*) in the region of the inner parenchymatous cortex, the outer collenchymatous band of cells remaining connected with the central portion of the stem by radial bridges of tissue (*br*) which correspond to portions of the cortex which have escaped disintegration. In the stem of *Malachra* growing as a land plant we have seen that owing to the more rapid growth of the vascular cylinder the latter comes almost into contact with the superficial layers. The occurrence then of large lacunae in the case of the stem of a plant growing in water can only be understood on the assumption that the growth of the superficial layers (including the collenchyma), which seems to receive an extra stimulus by immersion in water, keeps pace with the growth in diameter of the vascular cylinder.

We have already noted the extraordinary development of lenticels on the submerged parts of the stem. Like the normal lenticels occurring on the aerial parts these (Fig. 5, *l*) are seen to be developed from a phellogen which is continuous with the ordinary cork-forming phellogen (*Phel*) derived from the epidermis, but the complementary tissue differs from that of normal lenticels (1) in being more pronouncedly formed, (2) in the cells being more loosely applied to one another, (3) in their having living contents, and (4) in the cell walls not being brown and suberized, although they may be somewhat altered (since they stain yellow with chlor-zinc-iode). This hypertrophy of the lenticels in adaptation to water which has also been observed in some other plants (16) is a phenomenon similar to that which takes place on a larger scale when the ordinary cork-tissue is replaced by massive air-containing tissue called aerenchyma which is so marked a feature of certain marsh plants on which Lewakoffski (20), Schenck (27), Rosanoff (23), Scott and Wager (29), Schrenk (28), Witte (32), Batten (3) and others have worked.

It has been suggested (18) that the stimulus that causes the phellogen to develop aerenchyma in lieu of cork is the lack of oxygen in the inner tissues, or as Arber (1) puts it 'the presence of some minimum oxygen is possibly a necessary condition for the process of suberisation, which is inhibited when the oxygen-content of the cell-sap falls below a certain point'. This explanation does not seem to meet the case of lenticels, at any rate. It is well known that the surface waters contain more dissolved air, and consequently more oxygen, than the layers deeper down, and that dissolved air is richer in oxygen than atmospheric air. The fact that in this, as in other plants growing under marshy conditions, normal lenticels are concentrated at the water level, and lenticels are rarely, if ever, present lower down the stem, seems to suggest that for the production of lenticels a minimal amount of oxygen is necessary and that the further growth of lenticels is in proportion to the amount of this gas in the surrounding medium. On the other hand, as the aerial lenticels have suberized complementary cells and suberisation is absent in the submerged lenticels it would appear that suberisation of the lenticel tissue is correlated to the exterior condition of humidity, the drier the condition the more suberised the walls, and *vice-versa*.

Both the aerial and the submerged lenticels serve their purpose efficiently. The aerial lenticel permits of a direct access of atmospheric air to the inner tissues which, at the same time are kept from drying up by the loose plug of powdery suberised complementary tissue, while the living cells of the submerged lenticels are adapted for taking in dissolved air from the water which bathes them.

The transverse section of a young adventitious floating root which is given off from a submerged stem (Plate II, fig. 6) has a solid stele of xylem (*X*) surrounded by phloem (*Ph*), and a lacunar cortex. The young soil root has also a similar structure, the sizes of the lacunae depending upon the extent of humidity of the soil. An old soil root growing in water-logged soil (Plate II, fig. 7) or in ground covered with water shows large lysegenously formed air spaces situated between the outermost cortical region which develops cork and the

vascular cylinder. In soil roots growing under land conditions, however, these cortical air-spaces are obliterated, as in the case of the aerial stem, and the cork layers and the vascular cylinder are so juxtaposed as to make it appear that the cork-forming phellogen—which is actually superficial in origin—is derived from a deeper layer of cells situated immediately outside the pericyclic group of bast fibres. Another feature which distinguishes old soil roots growing in water-logged soil from those which live under dry land conditions is that in the former the peripheral region of wood shows large radially arranged gaps due to what appears to be a mucilaginous disorganization of cell groups in this part of the wood. Such gaps are not seen in the wood of roots growing under drier conditions.

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Explanation of Plates.

Plate I

Fig. 1.—Photograph of two plants of *Malachra capitata* L. grown: one (*left*) in water, the other (*right*) as a land plant. In the first the stem has swollen up and adventitious roots have developed on the submerged portion. The control plant to the right is quite normal. The scale is in inches.

Plate II

Fig. 2.—A habit drawing of *Malachra capitata* L. growing in water. *l*, lenticels; *b*, aerotropic roots borne on the horizontal roots *h* arising from the submerged portion of the stem; *c*, aerotropic roots sent up by the lateral underground roots. For clearness sake only a few roots are shown.

Fig. 3.—Portion of the transverse section of a young stem of *Malachra capitata* L. *Ep*, epidermis; *Hyp*, collenchyma; *Chl*, sub-epidermal chlorophyllous layers; *Cort*. inner parenchymatous cortex; *m*, mucilage cell. (× 45).

Fig. 4.—Portion of the transverse section of an older stem of *Malachra capitata* L. growing as a land plant, *A*, destroyed cells of the cortex; *Chl*, chlorophyllous sub-epidermal layers; *St*, portion of the stele represented in the fig. by the medullary rays (*m.r.*) and a portion of the hard bast (*B*); *Phel*, epidermal cells dividing to form the phellogen, (× 45).

Fig. 5.—Portion of the transverse section of the submerged part of a stem of *Malachra capitata* L. growing in water. *l*, lenticel; *Phel*, cork-forming phellogen derived from the epidermis; *Chl*, sub-epidermal chlorophyllous layers; *Hyp*, collenchyma; *a.s.* air-space; *br*, remains of the parenchymatous cortex forming bridges of tissue separating the air-spaces; *m.r.*, medullary ray; *B*, hard bast. (× 20).

Fig. 6.—Portion of the transverse section of an adventitious root of *Malachra capitata* L. given off from the submerged portion of the stem. *l*, lacunae in the cortex; *X*. xylem; *Ph*, phloem. (× 45).

Fig. 7.—Portion of the transverse section of a ground root of *Malachra capitata* L. growing in water-logged soil. *C*, cork; *a.s.*, air-space formed in the cortex; *m.r.* medullary rays; *B*, hard bast. (× 62).

(*To be continued*).

The Bokar of the Assamese and Katli of the Nepalese,
BARBUS (LISSOCHILUS) HEXAGONOLEPIS McClelland.

THE GAME FISHES OF INDIA.[1]

BY

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(*With one colour plate and seven text-figures*).

(*Continued from page 88 of Vol. xlii, No. 1*).

XII.—THE MAHSEERS OR THE LARGE-SCALED BARBELS OF INDIA.

5. The Extra-Indian Distribution of the Bokar of the Assamese and Katli of the Nepalese, *Barbus* (*Lissochilus*) *hexagonolepis* McClelland.

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INTRODUCTION.

In the list of synonymy of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland given in the preceding article (**12**, p. 81)[2] only Indian references to the species were included, and it was stated that its extra-Indian records could be dealt with in the next article. A careful study of the current literature on *Lissochilus* has shown that a heterogenous assemblage of species of the *Barbus*-group is at present included under this generic denomination. Though it is not within the scope of the present series of articles to discuss the systematic position of all such forms, in order to define the generic limits of the BOKAR of the Assamese it has been found necessary to make a few general comments on some of the allied species, especially those having affinities with the Indian fauna.

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[1] Published with permission of Director, Zoological Survey of India.

[2] Numerals in thick type within brackets refer to the serial numbers of the various publications listed at the end of the paper.

A number of species of *Lissochilus* described from Southern China, Siam, Burma, the Malay Peninsula and the Archipelago seem to us to be identical with the Nepalese KATLI, and have, therefore, to be regarded as synonyms of *B.* (*Lissochilus*) *hexagonolepis*. The list of synonymy given below and the discussion that follows indicate briefly our views concerning the systematic position of such forms. As a result of a careful examination of a large amount of material of *Lissochilus*, we have also discussed the value of certain specific characters generally relied upon for separating the species of this genus.

SYNONYMY.[1]

Barbus (Lissochilus) hexagonolepis McClelland.

1898. *Barbus Dukai*, Boulenger, *Ann. Mag. Nat. Hist.*, (6) XII, p. 201. (S. Shan States, Burma.)
1904. *Barbus soroides*, Duncker, *Mitt. Naturhist. Mus. Hamburg*, XXI, p. 178, pl. i, fig. 7. (Sumatra and Pahang, Malay Peninsula.)
1916. *Lissochilus dukai*, Weber & de Beaufort, *Fish. Indo-Austral. Archipel.*, III, p. 168. (Sumatra.)
1916. *Lissochilus sumatranus*, Weber & de Beaufort, *ibid.*, p. 169, figs. 68, 69. (Sumatra.)
1918. *Barbus dukai*, Annandale, *Rec. Ind. Mus.*, XIV, p. 35. (S. Shan States, Burma.)
1923. *Barbus* (*Lissochilus*) *dukai*, Hora, *Journ. Nat. Hist. Soc. Siam*, VI, p. 155. (Siam.)
?1925. *Barbus caldwelli*, Nichols, *Amer. Mus. Novitates*, No. 185, p. 2. (Fukien and Hainan, China.)
?1928. *Barbus* (*Spinibarbus*) *caldwelli*, Nichols, *Bull. Amer. Mus. Nat. Hist.*, LVIII, art. 1, p. 12, fig. 3. (Fukien and Hainan, China.)
1929. *Barbus hexastichus*, Prashad & Mukerji, *Rec. Ind. Mus.*, XXXI, p. 200, text-fig. 7. (Indawgyi Lake, Burma).
?1933. *Lissochilus caldwelli*, Lin, *Lingnan Sci. Journ. Canton*, XII, p. 214.
1934. *Lissochilus dukai*, Fowler, *Proc. Acad. Nat. Sci. Philadelphia*, lxxxvi, p. 120.
1934. *Lissochilus hutchinsoni*, Fowler, *ibid.*, p. 120, figs. 76, 77. (Siam.)
1936. *Lissochilus dukai*, Suvatti, *Index Fish. Siam*, p. 55. (Siam).
1936. *Lissochilus hutchinsoni*, Suvatti, *ibid.*, p. 55. (Siam.)
1936. *Lissochilus sumatranus*, Suvatti, *ibid.*, p. 55. (Siam.)
1937. *Lissochilus tweediei*, Herre & Myers, *Bull. Raffles Mus. Singapore*, No. 13, p. 61, pl. v. (Perak, F.M.S.)
1937. *Lissochilus dukai*, Fowler, *Proc. Acad. Nat. Sci. Philadelphia*, LXXXIX, p. 188. (Siam.)
1938. *Lissochilus dukai*, Fowler, *Fisheries Bull.*, No. 1, p. 66. (Malay Peninsula.)
1940. *Lissochilus hendersoni*, Herre, *Bull. Raffles Mus. Singapore*, No. 16, p. 10, pl. iv.

The first extra-Indian record of *Lissochilus hexagonolepis* (=*Barbus dukai* Day) is by Boulenger (**3**, p. 201) from Nampandet, S. Shan States, Burma; he had two specimens in which the number of scales along the lateral line varied from 26 to 28. The species was next recorded by Duncker (**4**, p. 178, pl. i, fig. 7) from the Malay Peninsula and Sumatra as *Barbus soroides*. He examined 12 specimens in all and noted that the number of scales

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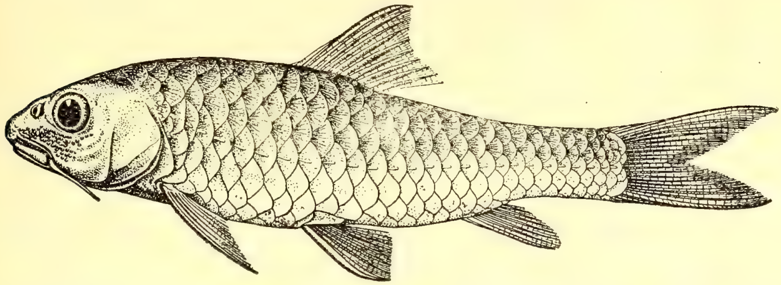
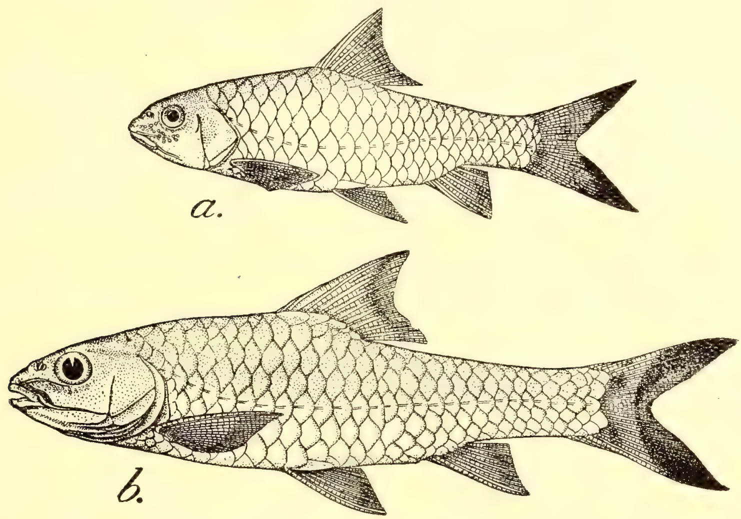
[1] In the list, references are included only of the extra-Indian records of the species.

along the lateral line varied from 26 to 29, while the number of predorsal scales was found to be 9 in all of them.



Text-fig. 1.—Lateral view of *Barbus soroides* Duncker. (After Duncker).

His figure of the species leaves no doubt that he was dealing with a true Katli. The identity of this species with that of Day's *B. dukai* was pointed out by Weber and de Beaufort (**23**, p. 168), who also described another new species of *Lissochilus, L. sumatranus,* from Sumatra. The description of this new species was based on a single specimen, 148 mm. in length; it was distinguished from *L. dukai* by the smaller number of scales along the lateral line



Text-fig. 2.—Lateral view of *Lissochilus sumatranus* Weber and de Beaufort, and of a specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from the Siju Cave, Garo Hills, Assam, showing black pigmentation on the lobes of the caudal fin.

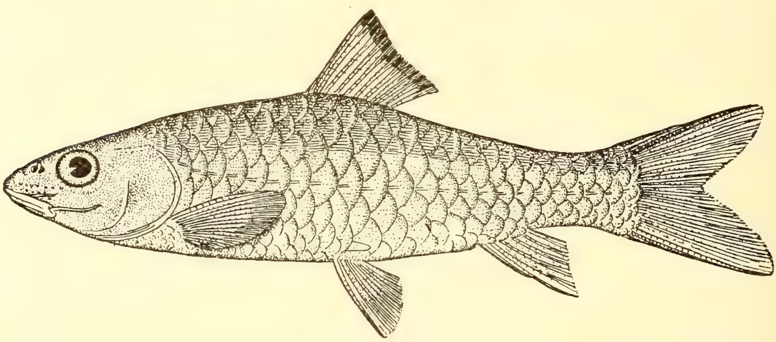
a. Lissochilus sumatranus Weber and de Beaufort. (After Weber and de Beaufort.); *b.* A specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from Assam. ×2/3.

(24-25 in *L. sumatranus* versus 26-29 in *L. dukai*). Hora (**12**, p. 82) has already shown in the case of the Indian specimens of *B. hexagonolepis* that the scales along the lateral line may vary

from 22 to 32, and in consequence no reliance can be placed on small variations in this character.

The only other striking point about *L. sumatranus* is the black colour of both the lobes of the caudal fin, but this feature is also partly shared by a specimen from the Siju Cave (2000 ft. from entrance), Garo Hills, Assam, in which the lobes of the caudal fin are darkish and there is a faint lunate dark band in the distal half of the dorsal fin. Suvatti (**22**, p. 55) recorded *L. sumatranus* from 3 localities in Siam, presumably on colouration and smaller number of scales along the lateral line. Without an examination of the Siamese examples, it is not possible to make any further observations on Suvatti's record of *L. sumatranus* from Siam, but a careful study of Weber and de Beaufort's description of the species and its comparison with the Indian specimens of *Lissochilus* have left no doubt in our minds that *L. sumatranus* is a synonym of *L. hexagonolepis*.

Annandale (**1**, p. 35) in 1918 and Hora (**10**, p. 155) in 1923 recorded the species from Burma and Siam respectively without any comments, but we have examined their material and find that it was correctly identified.

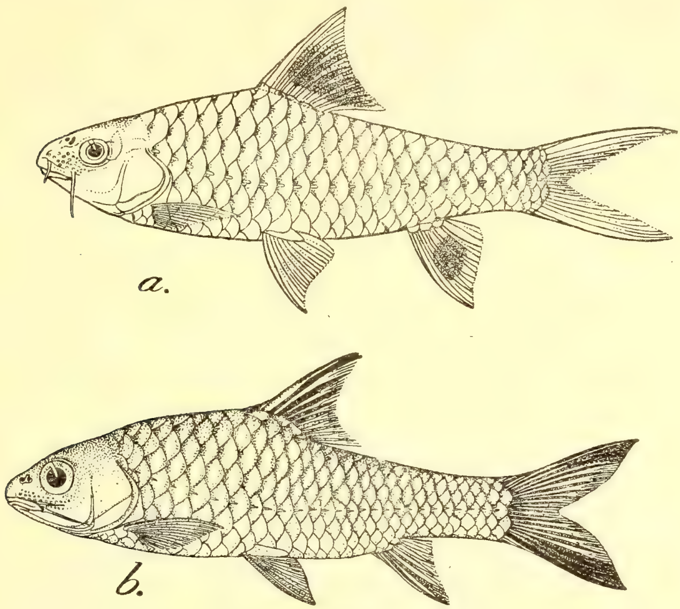


Text-fig. 3.—Lateral view of *Barbus caldwelli* Nichols. (After Nichols.)

In 1925, Nichols (**19**, p. 2) described a species of *Barbus*, *B. caldwelli*, from Fukien, China, characterized by 24 scales along the lateral line and 'left side of snout only with a band of small, crowded, warty points above the maxillary'. Later, he (**20**, p. 12, fig. 3) figured the species and included it in the subgenus *Spinibarbus* Oshima, but Lin (**15**, pp. 210, 214) placed it in the genus *Lissochilus*. From the description and figure of this species we are inclined to regard it a very close ally of *L. hexagonolepis*, if not absolutely identical with it. We have included references to *L. caldwelli* in the synonymy with a query so as to elicit further information about this form.

In 1934, Fowler (**5**, p. 120) described *L. hutchinsoni* from Nakon Sritamarat, Siam, from a specimen 148 mm. in length and stated 'Closely related to *Lissochilus sumatranus* Weber and de Beaufort, but that species figured and described with black ends to its caudal lobes, color uniform and ventral nearly reaching

anal.' This species is provided with 23 scales along the lateral line and 7 before the base of the dorsal fin. The membranes between the rays of the dorsal fin are stated to be dusky medially while those of the anal are dusky to blackish.



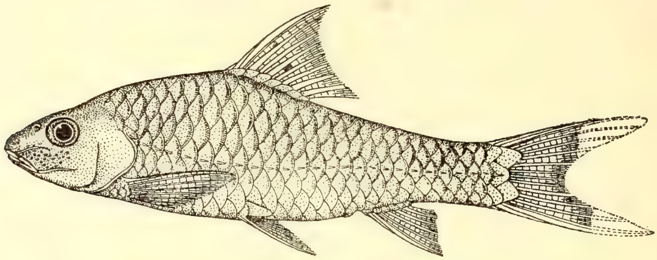
Text-fig. 4.—Lateral view of *Lissochilus hutchinsoni* Fowler, and of a specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland, showing the dusky colour of the interspinous membranes of the dorsal fin, etc.

a. Lissochilus hutchinsoni Fowler. (After Fowler.); *b.* A specimen of *Barbus* (*Lissochilus*) *hexagonolepis* McClelland from Balipara Frontier Tract, Assam. × *ca* 3/5.

We have noted that in fresh specimens the membranes of the dorsal, anal and caudal fins are dusky, but they never form a dark blotch on the anal fin as shown in Fowler's figure. The intensity of the colour-markings is an individual variation generally dependent on the nature of the habitat and, in consequence, we do not attach any specific value to it. Attention may also be directed to the fact that the individuals of the same species are generally more brightly coloured in Burma and the Far East as compared with those residing in the Indian waters. In the present state of our knowledge we regard *L. hutchinsoni* as a synonym of *L. hexagonolepis*. Fowler also recorded *L. dukai* from Siam.

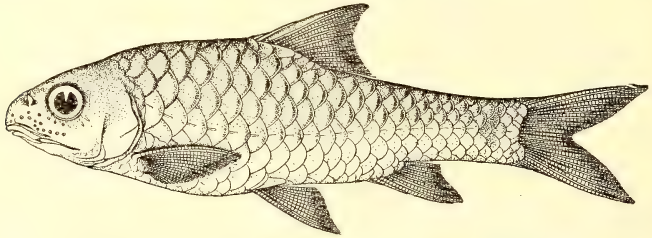
In 1937, Herre and Myers (8, p. 61) described *L. tweediei* from the River Yum, Perak, F.M.S.; the description is based on 4 specimens from 64 to 92 mm. in length. This species is provided with 26 scales along the lateral line and 8 predorsal scales and is distinguished from the other species of the genus 'in the very broad, sharp, horny edge to the lower jaw and the almost complete suppression or reduction of the lower lip.' This species is evidently based on very young specimens and the character of the lower

jaw and lip, as judged from the large number of Indian specimens of *Lissochilus* of all sizes examined by us, is not very constant. It not only varies with the nature of the environment but is also



Text-fig. 5.—Lateral view of *Lissochilus tweediei* Herre and Myers. (After Herre and Myers.)

liable to be affected by preserving fluid (**23**, p. 168). We have not found any other distinguishing feature in its description for separating it specifically from *L. hexagonolepis*.



Text-fig. 6.—Lateral view of a paratype of *Lissochilus hendersoni* Herre. *Nat. Size.*

Recently Herre (**6**, p. 10) described another species of *Lissochilus, L. hendersoni,* from Malaya (Penang Island). His description is based on 28 specimens from 59-70 mm. in length. This species is also based on juvenile examples in which the number of scales along the lateral line is 23 and the predorsal scales are 5-6. We have examined paratypes of this species and find that it cannot be separated specifically from the young of *L. hexagonolepis.* There are 23-24 scales along the lateral line and 6-7 before the base of the dorsal fin. Its so-called strong dorsal spine is not quite as strong as the spines of certain Indian specimens collected from the streams flowing through the limestone rocks. We showed such specimens to Dr. Herre during his recent visit to Calcutta and generally discussed with him the status of the extra-Indian species of *Lissochilus* described from the Malay Peninsula. He informed us that when describing *L. tweediei* and *L. hendersoni* he was not aware of the fact that these fishes attained a huge size and a weight of many pounds. In view of the great range of variation exhibited by the Indian specimens of *L. hexagonolepis* he was also of the opinion that all the Malayan species referred to above should be treated as synonyms of *L. hexagonolepis*.

Status of the Chinese Species of *Lissochilus* Weber & de Beaufort and the Systematic Position of *Poropuntius* Smith.

There is a group of Chinese, *Barbus*-like forms which have been assigned by various authors to *Lissochilus*. In recent years Herre and Myers (**7**, pp. 242-247), Myers (**18**, pp. 257, 258) and Lin (**15**, pp. 209-215) have discussed the systematic position of these species, but as we have not examined any specimen from China we are not in a position to deal with the matter further, except to make a few general comments on the information contained in the published accounts.

Herre and Myers, and Myers included the following 9 species from China in the genus *Lissochilus*:

1. *Lissochilus labiatus* (Regan).
2. *Lissochilus monticola* (Günther).
3. *Lissochilus hemispinus* (Nichols).
4. *Lissochilus barbodon* (Nichols and Pope).
5. *Lissochilus kreyenbergii* (Regan).
6. *Lissochilus formosanus* (Regan).
7. *Lissochilus invergatus* (Oshima).
8. *Lissochilus fasciatus* (Steindachner).
9. *Lissochilus paradoxus* (Günther).

Lin did not include species Nos. 6, 7 and 9 in his synoptic table of the genus, but added *L. styani* (*Boulenger*), *L. rendahli* (Lin) and *L. caldwelli* (Nichols) to the genus *Lissochilus*. Later, he (**16**, p. 307) described another species in this genus—*L. clivosius*. We have already referred (*vide supra*, p. 308) to the systematic position of *L. caldwelli* and indicated its close affinity to *L. hexagonolepis*. In the remaining species the number of scales along the lateral line is generally 40 or more. They are not stated to grow to a very large size and most of them are characterized by the possession of short vertical bars across the body. The nature of the dorsal spine (weak or strong; smooth or serrated), and the character of the lower jaw and lips are variable. Reliable information regarding the position and extent of the tubercles on the snout of the Chinese species is not available. In *L. styani* they are stated to be present on the tip of the snout while in true *Lissochilus* they are between the maxillaries and the eyes. While agreeing with Herre and Myers that in recognising genera among the Cyprinidae a difference of 10 scales in the count along the lateral line is not a valid generic character, we feel that this difference coupled with the geographical position of the two groups merits some sort of distinction. Species of *Lissochilus* of the *hexagonolepis*-type are not only large-scaled but also grow to a large size and are mostly confined to the Brahmaputra and Chindwin drainages in India, Burma, Siam, Malay Peninsula and the Archipelago. The species with the small scales are mostly confined to Southern China. In his treatment of the Cyprinoid genera with a procumbent predorsal spine, Hora (**11**, pp. 311-319) recognised groups on geographical distribution and assigned them subgeneric ranks. We consider that a somewhat similar procedure will meet the need of the situation here, for the time being at least.

There is yet another group of species usually referred to *Lissochilus* for which H. M. Smith (**21**, p. 14) had proposed the name *Poropuntius* and remarked :

'This genus resembles *Lissochilus* from Southern Asia and Sumatra, in having the lower jaw covered with a horny sheath and a deep sulcus separating it from the lower lip. The pores on the snout in *Lissochilus* are surmounted by horny tubercles which extend to below the eye, and the last simple dorsal ray is weakly ossified and not denticulated. There is no rostral groove.'

The type-species of the genus, *P. normani*, was described from Siam from a single specimen 10.5 cm. in length; it is characterized by the possession of 31 scales along the lateral line and 11 before the dorsal fin. Another species of this type was described by de Beaufort (**2**, p. 34) from Johore, Malay Peninsula, and placed in the genus *Lissochilus*, *L. smedleyi*. He observed that :

'This species is closely allied to *Poropuntius normani*, recently described by H. Smith (*Proc. U. S. Nat. Mus.*, Vol. 79, 1931, p. 15) from Siam. This species differs from *L. smedleyi* in the following points: 14 scales round caudal peduncle, interorbital space flat, osseous part of dorsal spine equal to head less snout, ventrals and pectorals subequal 1.25 in head.'

Before considering the generic validity of *Poropuntius* reference may be made to other species of *Barbus* of the *Poropuntius*-type. In 1923, one of us (**10**, p. 155) referred three specimens from Koh Chang, Siam, to *Barbus deauratus* Cuvier & Valenciennes,[1] and included them in the subgenus *Lissochilus*. Evidently no importance was then attached to their serrated dorsal spine or the position

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[1] There seems to be a certain amount of confusion regarding the nature of the dorsal spine of *Barbus deauratus*. Cuvier and Valenciennes (*Hist. Nat. Poiss.*, vol. xvi, p. 188, 1842) noted that 'le rayon de la dorsale est grêle, lisse'. The length of the specimen (? specimens) examined by them is stated to be 'quatre pouces et demi'. Günther (*Cat. Fish. Brit. Mus.*, vol. vii, p. 128, 1868) gave a very brief description of the species after Valenciennes and noted that 'The osseous dorsal ray is slender and smooth.' Sauvage [*Nouv. Archiv. Mus. Hist. Nat. Paris,* (2), vol. iv, p. 183, pl. vi, fig. 5, 1881] redescribed the species from a specimen 125 mm. in length, and made the following statement regarding the dorsal fin :

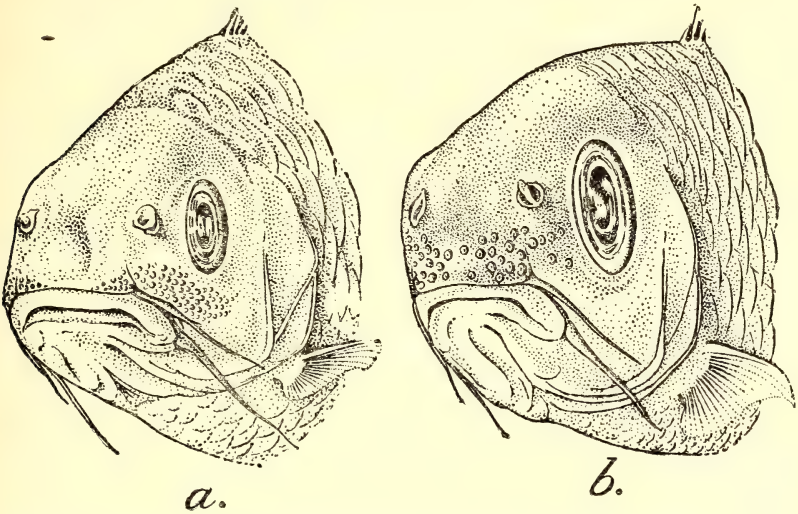
'Dorsale placée plus près de l'extrémité du museau que de l'origine de la caudale, insérée au-dessus des ventrales ; troisième rayon osseux, faiblement dentelé, aussi long que la tête, sans le museau.'

The Koh Chang specimens assigned by me (**10**, p. 155) to *B.* (*Lissochilus*) *deauratus* possess strongly denticulated dorsal spine and in other respects also agree very closely with Smith's (**21**, p. 14) description of *Poropuntius normani.* Suvatti (**22**, pp. 55, 56) recorded both *L. deauratus* and *P. normani* from Siam but it is not stated how he distinguished the two species. The presumption is that Suvatti's specimens of *L. deauratus* from the Pattani River, Khau Banthat, Ko Chang and Pak Chong are characterized by a smooth dorsal spine.

It is not possible under the present conditions to get any further information regarding the nature of the dorsal spine in the type-specimen of *B. deauratus.* If on a re-examination the dorsal spine is found to be smooth and the anterior part of the snout is free from pores, then it will be synonymous with *B.* (*Lissochilus*) *hexagonolepis,* but if the dorsal spine is denticulated and the pores cover the anterior part of the snout, then it will be congeneric with *P. normani.* Mr. Misra, relying on the descriptions of Valenciennes and Günther, is of the opinion that *B. deauratus* is a synonym of *B. hexagonolepis,* the range of which will be thus extended to Cochin-China also.

S. L. Hora.

of the tubercles on the snout. We find that H. M. Smith's description of *P. normani* agrees very closely with the specimens of *L. deauratus* in the collection of the Zoological Survey of India.



Text-fig. 7. *Lissochilus* Weber and de Beaufort, and *Poropuntius* Smith, to show position of tubercles on the snout.
a. Barbus (*Lissochilus*) *hexagonolepis* McClelland from Tavoy. *Nat. Size*; *b. Barbus* (*Poropuntius*) *normani* Smith. × 3.

Barbus clavatus McClelland, redescribed by one of us (**9**, p. 185) from Assam is also a *Poropuntius,* though in the description no mention is made of the tubercles on the snout. We have now examined large series of specimens from different localities in Assam, and find that the presence of tubercles in the anterior part of the snout is a constant feature of the species. It is provided with 40-42 scales along the lateral line and 14 in front of the dorsal fin. A variety of this species, *B. clavatus burtoni,* was described by Mukerji (**17**, p. 64) from the Myitkyina District, Burma. This variety was distinguished from the typical form by 'its longer snout, shorter third spine of the dorsal fin, fewer scales along the lateral line, in a transverse series and before the dorsal fin, and by the colouration which is more dark than bright and silvery'.

Attention may here be directed to the fact that in South India also there are certain species of *Barbus* (*sensu lato*), *B. mysorensis* Jerdon for example, in which the snout is covered with horny tubercles and the number of scales along the lateral line is in the neighbourhood of 40. We have not investigated the exact generic limits of these fishes, but they seem to bear close affinities to certain Chinese species referred to above.

From the foregoing account it is clear that *Poropuntius* is fairly widely distributed in South-Eastern Asia—Assam (*P. clavatus;* L. l. 40-42), Burma (*P. clavatus burtoni;* L. l. 35-38), Siam, Cochin-China, Malay Peninsula (*P. deauratus*; L. l. 31) and Malay Peninsula (*P. smedleyi,* L. l. 27-28). It is remarkable that the

scales become larger and fewer as we travel away from India to the east and south. The same conclusion was reached by us (**13**, pp. 268, 269) in our studies on *Barbus* (*Puntius*) *ticto* and *Rohtee cotio* (**14**, pp. 166-171), and the same is true of the large series of specimens examined by us of *Lissochilus hexagonolepis.* As to the significance of this change in lepidosis, we are not in a position to give any explanation.

An examination of a large number of specimens of *Lissochilus* and *Poropuntius* has convinced us that both the names can be regarded as valid subgenera which can be distinguished on the character of the dorsal spine and on the position of the tubercles on the head. Whether the *Poropuntius*-type of *Barbus* is represented in the Chinese and South Indian species referred to above requires further elucidation. In the absence of any Chinese material we refrain from discussing this matter further, but there seems a possibility that some of the Chinese species may belong to *Poropuntius,* and in that case some earlier generic name, such as *Lissochilichthys* Oshima and *Acrossocheilus* Oshima will have precedence.

As regards *Lissochilus,* we propose to restrict it to comparatively large-scaled Barbels of the *hexagonolepis*-type with from 22 to 32 scales along the lateral line, a smooth dorsal spine and with the tubercles not extending to the tip of the snout. In the present state of our knowledge there seems to be only one widely distributed species of this genus.

Variations and Bionomics.

The head is proportionately larger in young specimens and its length with reference to the standard length varies from 3.27 in a specimen 76.5 mm. long to 4.32 in a specimen 208 mm. long. The height of the head and its width also vary in the same way. Similarly the eyes are considerably larger in young specimens. The tubercles on the snout begin to appear at a very young age; we have noted two tubercles above the origin of maxillary barbels in a specimen 27 mm. in standard length. The arrangement and number of tubercles vary considerably even in specimens from the same locality, and it seems probable that sexual differences may be responsible for this variation. The barbels are also proportionately longer in young specimens. In the preceding article of this series reference has already been made to the great variation exhibited by the dorsal spine, and the same has been found to be true in the case of the extra-Indian specimens. The size and strength of the dorsal spine seems to vary with locality. The lepidosis varies with age and locality, there may be 22-32 scales along the lateral line, 7-11 predorsal scales, 12-14 scales round caudal peduncle and $2\frac{1}{2}$ to $3\frac{1}{2}$ series of scales between the lateral line and the base of the pelvic fin.

Reference has been made in the earlier article to the great variation in colouration exhibited by this species. In the two colour illustrations reproduced here some further differences may be noted. In a specimen from Pegu, 204 mm. in standard length, Mr. D. E. B. Manning noted that the back was of a deep olive colour followed on

the sides by a band of light prussian blue below which the body was silvery white. The head was of a reddish brown colour, somewhat lighter in the opercular region. In the sub- and post-opercular regions and along the edges of the scales the colour was light cadmium. The iris was light cadmium orange. The dorsal and the caudal fins were of a light reddish brown while the other fins were of a light purplish grey colour. Mr. Manning characterised this species as the 'Olive Mahseer' and noted that he caught the fish in the Pathi stream, a feeder of the Sittang river. 'A clear granite boulder stream which holds mahseer up to about two pounds in weight. The fish take a dry spoon freely. Burmese name in the locality is *Nga-Dank-Ma'*. Mr. Manning noted its great resemblance to the 'Gold' or 'Red Mahseer' of the Tavoy District, but stated that it 'is perhaps not quite so golden and it appears to have 25 scales along the lateral line'.

In the 'Red Mahseer' of the Tavoy District, Mr. Manning noted that the back was darkish greeny brown which looked purple while under water. Below this up to the lateral line the scales were golden with deep antwerp blue bases and madder brown margins. In the region of the lateral line the scales were of a lighter golden colour. The lower part of the body was silvery white and the scales were encircled with brown spots. The sides of the head were light golden yellow while the opercular region was reddish golden yellow. The iris was light orange yellow. The dorsal fin was yellowish brown while the other fins were of a light raw umber colour. The bases of the pectoral, pelvic and anal fins were pinkish.

Mr. Manning supplied the following notes on the habitat and bionomics of the 'Red Mahseer':—

'Very common in the clear rocky streams of Tavoy and Mergui. They run very small and the best I have ever seen could not have been over 20 pounds. The average is nearer 7 pounds as a limit in most streams. The fish normally lie up in the deep still pools and only exceptionally will they be taken in rapid water. Shoals roam round the pools preferring those that are deep and black and rocky. The fish do not normally lie in the rocky fast headwaters but drop down to the slow deep rocky pools.

'They run up to spawn about the end of May to June and stay up till the end of September when they go down on one of the late rises. At these times they are found in the rocky swift headwater streams. Throughout the year they appear to be in grand condition and appear to be very fat in comparison with the Indian mahseer.

'They take best in the hot weather and I suggest that this is a matter of scarcity of food and nothing else. In the rains and early cold weather the food is plentiful. All the fish in Tavoy take better in the hot weather.

'*Food.*—They are very partial to *thingan* (*Hopea odorata*) leaves which blow down in plenty in November to January with the morning north-east winds. At such times the Karens catch them with leaves baited on to hooks which are allowed to dangle on the surface from fixed rods. I have seen them jumping out of the water to get the leaves of a *Ficus* tree which had fallen. All the leaves within about 6 inches of the water were stripped. They also eat small fish, insects, etc., but the main part of their diet appears to be green food. They take spoons freely preferring a silver and gold or silver and copper spoon in my opinion. I have never taken them on a fly.

'There appear to be two different mahseer from the pores over the mouth. This is thought to be a matter of sex and Burmans tell me that the female has very numerous pores and the male but few.'

MEASUREMENTS IN MILLIMETRES AND SCALE-COUNTS OF SPECIMENS OF *BARBUS* (*LISSOCHILUS*) *HEXAGONOLEPIS* McCLELLAND FROM BURMA

	Kamaing, Myitkyina Dt.	Talokt-win, Sittang drainage	Pegu				Tavoy				
Total length	...	191·5	...	212·0	...	...	...	310·0	335·0	342·0	460·0
Standard length	202·0	144·5	116·0	161·0	204·0	235·0	230·0	240·0	265·0	270·0	365·0
Length of head	51·5	39·0	30·3	41·0	48·5	56·0	55·0	58·5	64·5	68·4	92·5
Height of head	36·5	30·0	24·5	31·0	39·0	45·0	42·0	44·3	50·0	53·0	67·5
Width of head	32·8	26·8	19·5	28·5	35·0	41·5	39·0	37·0	41·1	44·0	61·2
Diameter of eye	13·5	11·0	10·5	13·0	14·0	15·3	39·0	16·2	17·5	17·5	22·5
Length of snout	14·0	11·0	9·0	12·0	13·5	18·0	15·0	20·0	22·0	20·9	31·0
Interorbital distance	19·5	15·0	11·0	17·0	21·5	24·5	17·5	21·1	29·0	28·2	39·0
Width of body	30·5	26·5	22·0	31·5	36·5	46·5	22·0	34·2	42·5	43·5	63·5
Depth of body	51·4	42·5	37·0	53·1	65·3	70·5	40·0	62·0	81·0	83·0	93·5
Length of caudal peduncle ...	35·0	24·5	18·5	25·5	30·0	34·0	68·0	40·0	44·0	39·0	54·0
Least height of caudal peduncle ...	23·0	17·0	15·0	22·0	25·0	29·0	41·0	27·0	32·5	33·5	38·4
Length of dorsal fin	D.	34·0	D.	D.	33·0	41·3	28·0	43·0	49·0	48·0	64·0
Length of pectoral fin	38·5	30·0	24·0	35·0	41·0	47·0	50·5	49·0	54·0	58·5	70·0
Length of pelvic fin	31·0	27·0	21·5	31·3	35·5	40·5	42·0	41·5	41·0	41·3	57·5
Length of anal fin	29·0	27·0	21·0	28·3	35·5	45·0	35·0	46·0	51·0	57·0	72·0
Length of rostral barbel ...	13·0	12·5	9·0	13·0	14·5	17·0	17·5	13·0	14·0	19·0	21·5
Length of maxillary barbel ...	14·5	13·5	9·5	16·0	21·5	24·0	23·5	16·0	23·5	25·0	22·5
No. of predorsal scales ...	8	9	9	9	8	8	9	D.	8	8	8
No. of scales along L. l. ...	26	26	26	25	24	25	26	25	24	22	24
No. of scales between L. l. and V.	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½

MEASUREMENTS IN MILLIMETRES AND SCALE-COUNTS OF SPECIMENS OF *BARBUS* (*LISSOCHILUS*) *HEXAGONOLEPIS* McCLELLAND FROM MALAY PENINSULA AND SIAM

	Malay Peninsula														Siam
	R. Ketil, Kelantan			R. Sepia, Pahang	Kuala Terla, Pahang			R. Mertang, Negri Sambilan		W. of Ginting Sempak, Selangor			Penang Island		Nakon Srita-marat
Total length	141·0	219·0	327·5	372·0	130·0	144·5	159·0	91·0	100·5	82·6	104·5	107·0	85·0	87·0	...
Standard length ...	110·0	167·0	252·5	287·0	99·5	110·0	120·0	69·0	74·0	63·0	76·5	83·0	66·0	67·0	147·5
Length of head ...	27·5	43·5	64·5	75·0	27·5	30·0	32·5	19·0	21·0	17·5	23·2	24·0	18·0	18·0	42·3
Height of head ...	20·5	34·0	49·5	58·0	20·0	22·0	23·0	15·0	15·5	13·5	16·5	18 0	13·9	14·0	31·5
Width of head ...	17·2	29·0	41·0	51·5	14·5	17·0	18·0	12·5	12·5	10·0	13·5	15·0	10·5	11·0	29·0
Diameter of eye ...	9·0	12·0	16·0	18·0	8·5	9·5	9·5	7·3	7·5	6·3	7·3	7·3	6·3	6·3	11·0
Length of snout ...	9·0	13·5	21·0	25·0	8·5	8·5	11·0	6·0	6·0	5·0	7·0	8·0	5·0	5·2	13·0
Interorbital distance ...	10·0	16·5	27·0	31·7	9·5	10·0	10·5	6·0	7·0	5·6	7·0	8·0	6·0	6·0	15·5
Width of body ...	17·2	29·0	41·0	51·5	14·5	17·0	18·0	11·5	11·5	9·5	12·0	14·0	10·5	11·0	22·5
Depth of body ...	31·0	51·0	72·5	91·0	26·5	24·5	32·5	21·0	21·5	17·5	21·0	23·0	21·0	20·5	38·3
Length of caudal peduncle	22·0	29·0	42·5	55·0	16·0	17·0	20·5	12·5	13·5	13·0	14·9	15·0	12·0	13·0	24·0
Least height of caudal peduncle	14·0	20·0	31·5	35·0	10·3	12·5	12·5	9·0	9·0	8·0	9·0	9·0	8·5	8·5	15·5
Length of dorsal fin ...	25·0	38·0	55·0	66·5	21·0	25 0	26·5	20·0	19·5	16·0	19·0	18·5	18·0	18·0	29·0
Length of pectoral fin ...	23·0	34·0	50·0	70·0	20·0	23·0	25·0	17·5	17·5	15·0	17·0	18·0	15·5	15·7	28·0
Length of pelvic fin ...	20·5	29·5	38·5	52·5	16·0	17·5	21·5	13·0	15·0	13·2	16·0	15·0	14·0	13·0	21·0
Length of anal fin ...	21·5	29·5	49·5	67·0	16·5	18·0	21·5	13·0	16·0	13·0	15·0	15·5	13·5	13·0	26·5
Length of rostral barbel...	7·5	12·5	19·0	24·0	8·0	8·0	10·0	7·5	8·5	5·5	7·0	7·0	5·5	5·5	13·5
Length of maxillary barbel	9·5	14·0	25·5	32·5	9·0	12·0	11·0	8·0	9·0	6·0	7·5	7·5	7·0	6·5	14·5
No. of predorsal scales ...	9	9	9	8	8	8	8	6/7	8	8	8	7/8	8	7/8	8
No. of scales along L. l ...	27	27	27	26	25	27	25	22–24	24	26	25	24	24	24	25–26
No. of scales between L. l and V	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½	2½

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Explanation of Plates.

Barbus (*Lissochilus*) *hexagonolepis* McClelland.

The two colour drawings reproduced on this plate were made from sketches, notes and specimens supplied by Mr. D. E. B. Manning, Divisional Forest Officer, Burma, and portray variation in colouration exhibited by the species in different waters.

The upper illustration is from a specimen of the 'Olive Mahseer' of the Pegu District, while the lower one represents the 'Gold' or 'Red Mahseer' of the Tavoy District. However, both the colour varieties represent the same species and show that much reliance cannot be placed on colouration alone in distinguishing species of the large-scaled Barbels of India.

For details of colouration see pp. 314, 315 above.

A NEW SPECIES OF COLEUS

BY

K. CHERIAN JACOB, L.Ag., F.L.S.

(*With a plate*).

Coleus vettiveroides K. C. Jacob, sp. nov. Labiatae—Ocimoideae.

Ab aliis speciebus differt radicibus, 'quae sunt aromaticae dum sint integrae.'

Herba succulenta, 45 cm.-53 cm. altitudine, fruticosa, ramis aliquantulum decumbentibus. Truncus 1.25 cm. diametro, leniter sub-purpureus, pubescens, cum albis, brevibus capillis, axis primaria plus minus quadrilateralis, ramis fere teretibus. Folia opposita; petioli 4-6 cm. longi, pubescentes, subpurpurei, ventro sulcato dorsoque tereti; lamina crassa, fere rotunda, 8-10 cm. longa, 9-12 cm. lata, superiori superficie sparse pubescens, inferiori superficie dense pubescens; nervi palmati; nervi praecipui 12, insuper demersi, desuper valde elati et prominentes; superficies rugosa; margines dentati. Radices fibrosae; 35 cm.-50 cm. longae si arenoso solo crescant, stramineo colore, post unum alterumve diem nigri evadentes, aromaticae dum sint recentes.

Plantae flores nemo unquam vidit.

Coleus osmirrhizon Elliot nomen tantum in Herbarium Madras (Coimbatore) No. 40, 797.

Herb succulent, 45 cm.-53 cm. in height, bushy with slightly decumbent branches; stem 1.25 cm. in diameter, slightly purplish, pubescent with white short hairs, main stem more or less four-sided and branches nearly terete; leaves opposite; petioles 4 cm.-6 cm. long, pubescent, purplish, ventrally furrowed, dorsally rounded (terete); lamina thick, nearly rounded, 8 cm.-10 cm. long, 9 cm.-12 cm. broad, sparsely pubescent on the upper surface and densely pubescent below; nerves palmate, main nerves 12, sunk above and very much raised and prominent below; surface puckered; margins dentate. Roots fibrous, 35 cm.-50 cm. long when grown in sandy areas, straw-coloured, turning dark after a day or two, aromatic when fresh.

The plant has so far been seen only under cultivation at Shiyali, Tanjore District; Palni in Madura District; Conjeeveram in Chingleput District, etc., in the Madras Presidency and it has not been seen in flower anywhere at any time. The plants were specially grown at Shiyali in Tanjore District, South India, a natural habitat and at Coimbatore. All attempts at inducing flowering have failed at both places. There is a specimen of this plant in the Madras Herbarium at Coimbatore labelled *Coleus osmirrhizon* Elliot. Tamil: Kuru Veru, collected at Mahabalipuram, Chingleput District, by T. Abboy Naidu on the 25th May, 1879. This name (*Coleus osmirrhizon* Elliot) could not be traced in any of the literature available here. The Curator of the Herbarium, Royal Botanic Gardens, Sibpur, Calcutta, considers it as only a manuscript name. This specimen also is without flowers.

There is a good deal of confusion in the local names of the scented roots of *Vetiveria zizanioides* Nash. (a grass) and those of this species of Coleus, the specific name of which has not been determined. With a view to clarify this confusion, a questionnaire was sent to some of the most important places where these two roots are very well known locally, and information obtained through the Agricultural Departmental Officers. Four local names, viz., Vetti ver, Kuru ver, Velamichai ver and Ramacham were reported to be in common use for these two scented roots. The consensus of opinion is that Vetti ver and Kuru ver are synonyms and are used for the roots of the Coleus species and Velamichai ver and Ramacham are two linguistic names for the grass, *Vetiveria zizanioides* Nash., the former in Tamil Districts, and the later in Malayalam speaking Districts and States.

Coleus vettiveroides K. C. Jacob. sp. nov.
Plant about four months old. Height $1\frac{1}{2}'$, Spread $2\frac{1}{4}'$.

The roots of this Coleus species are known as Vettiver in Tanjore, North Arcot, Coimbatore, Madura, Tinnevelly and Ramnad Districts. The same root is known as Kuru ver in Chingleput, Tanjore, North Arcot and parts of Madura Districts. Vetti ver and Kuru ver are synonymously used in Tanjore, North Arcot and parts of Madura Districts.

In Shiyali Taluq of the Tanjore District where this Coleus species is extensively cultivated on the sandy banks of the Coleroon river, the names Vetti ver and Kuru ver are synonymously used. At Palni in Madura District where it is under cultivation in sandy garden lands it goes by the name Vettiver and at Conjeeveram in Chingleput District where it is cultivated on the banks of the Vegavathi river it is known as Kuruver.

The fresh fragrant roots of Vettiver (Kuruver) are used from time immemorial in the decoration of the idols in the South Indian temples of the Tamil Districts and also in the ladies' toilet for dressing hair.

The well-known Khus-khus or Cuscus of Commerce is known as Velamichai or Velamichaver in all the Tamil Districts, viz., Tanjore, North Arcot, Madura, Tinnevelly, Coimbatore, etc. In parts of Tinnevelly District it is also known as Lamacham or Ramacham ver. Ramacham is the well-known name for this root unmistakably used throughout the Malayalam speaking area. It is called Vetti ver at Vellaikulam in Chingleput District adjoining the Telugu area.

The fragrant dried roots of the Khus-khus are used for making mats, chick-thatties, fancy fans and 'Kavadies'. It is also employed in the adulteration of Vettiver at Srivilliputtur, Ramnad District. These roots are scented only at certain seasons of the year (*Madras Agricultural Department Year Book* 1918, pp. 67-69). It is extensively cultivated on the coastal regions of the Ponnani Taluq of the Malabar District. It is also grown to a limited extent at Srivilliputtur in Ramnad District mainly for adulterating with the roots of Vettiver (*Coleus* sp.). This grass is found commonly in swampy or moist situations in Mysore, South Kanara, Malabar, Coimbatore, Chingleput, South Arcot, Nellore, Kistna, Godaveri, Vizagapatam and other Districts. But the extraction of Khus-khus at the proper season and the manufacture of chick-thatties, fans, etc., are carried on as a cottage industry by the moplah community (Malayalam speaking Muhammadans) of the Ponnani taluq in the Malabar District.

The dried roots of this grass retain the pleasant and strong aroma for a very long time even for some years, while only fresh roots of Vettiver (Coleus sp.) are scented and made use of since they become odourless as they dry up in the course of 3 or 4 days. The fresh Vettiver roots are straw-coloured but soon become dark as they dry up, while those of Khus-khus retain the straw colour even after drying.

In the Telugu Districts of this Presidency starting from the Chingleput District right up to Ganjam, Khus-khus roots are known as Vetti ver. The idols in the Telugu temples are not generally decorated with any scented roots. Since Khus-khus is known as Vetti ver, the products of Khus-khus, viz., chick-thatties, fans, etc., are also known as Vettiver thatties, fans, etc., in these parts.

It has already been shown that Khus-khus and Vettiver (also known as Kuruver) are the roots of two different kinds of plants but are recognised by different conflicting names in different localities of this Province. This misnomer in the local name has been carried so far that the local name of the Coleus species was given to a species of grass, *Vetiveria odorata* Virey., as early as 1827. Hooker, in the *Flora of British India*, puts Vetiveria as a subgenus of Andropogon and called this plant *Andropogon squarrosus* Linn. f., but Gamble, in the *Flora of the Presidency of Madras*, names this grass as *Vetiveria zizanioides* Nash. The local name of this *Coleus* has become the generic name of a group of grasses, one of which has scented roots.

The origin of the name Vettiver for Khus-khus in Telugu parts is not known. The following explanation is suggested :—

T. Abboy Naidu's specimen of this *Coleus* was collected in the year 1879, near Madras and is known as Kuruver. Telugu area begins with Madras. This *Coleus*, therefore, might have been known to Telugus as Kuruver. The Telugus who visit the famous South Indian temples might have become familiar with Vettiver roots which are used to decorate the

idols in those temples. It is likely that they might have been ignorant of the two different names Kuruver and Vettiver for the same plant. They might have hence thought that Vettiver might be the roots of the Khus-khus plant which are also scented. During the time of the East India Company, Samalkota, in Telugu country, was a centre of botanical study and the name Vettiver might have been first introduced into botanical works somewhere here.

Vettiver or Kuruver (*Coleus* sp.) is largely cultivated on the river banks in sandy loams. It is propagated by planting young shoots and plants are ready for lifting in about 4 months when the roots would have attained the maximum length and possessed with best aroma. It needs heavy manuring and constant watering.

This species of Coleus which has not so far been correctly named is designated as *Coleus vettiveroides* K. C. Jacob. The specific name *vettiveroides* is after the most popular Tamil name of the plant in places where it is largely cultivated.

Type in Madras Herbarium, Coimbatore: Madras Herbarium No. 85,676.

My thanks are due to Father A. Rapinat, S. J., Professor of Botany, St. Joseph's College, Trichinopoly, for kindly rendering the English description into Latin, to Rao Bahadur G. N. Rangaswami Ayyangar, F.N.I., I.A.S., Geneticist and Principal, Agricultural College, Coimbatore, and Dr. N. L. Bor, Forest Botanist, Dehra Dun, for their valuable suggestions.

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MARINE SHELLS OF MADRAS.

BY

M. D. CRICHTON.

(*With* 4 *plates*).

Melvill and Standen[1] computed the total of Madras marine mollusca at slightly over 700 of which, approximately, 470 were univalves and 230 bivalves. It should be noted, however, that the collections examined by them when compiling their catalogue included specimens from the neighbourhood of Pamban, a distance of 235 miles by sea from Madras, where coral formation predominates in marked contrast to the unrelieved sand of the southern portion of the East Coast of India. As there are many mollusca peculiar to coral-reef conditions which are not found elsewhere there would appear to be reason—if only as a matter of local interest—for keeping separate a record of species which are known to make their homes, in some cases it may be only as temporary visitors, within sound of the surf of the Coromandel Coast.

I have had opportunities of collecting at many places along the shores of this coast besides dredging down to 6 or 8 fathoms off Pondicherry, Cuddalore, Porto Novo, and Negapatam, and to a greater depth at Madras, and am satisfied that the forms found at Madras may be regarded as typical of the entire coast, say from Point Calimere (Lat. 10° 18′ N.) to Cocanada (Lat. 17° N.). The territory covered by these notes, however, will be confined to the strip of sea-board in the immediate vicinity of Madras, extending about thirty miles from Ennur towards Covelong in the south. Apart from the harbour area the coast presents an unbroken vista of yellow sand except where intersected by the channels of the backwater at Ennur and of the Cooum and Adyar, two small rivers whose egress is barred periodically by great banks of sand piled up during the dry months following each north-east monsoon.

Consequently the mollusca comprise chiefly the dwellers in sand and mud, the only rock habitations being those provided by the hand of man, such as the blocks of concrete and stone placed as breakwaters for the protection of the harbour walls and the revetment immediately north of Royapuram Bay. The total number of species known to Madras exceeds 700, approximately 500 univalves and 230 bivalves. This total is constantly being added to. The mollusca here enumerated should be taken merely as a general indication of some of the species to be found.

THE LITTORAL ZONE.

The number of living mollusca within reach of the seeker along the shore is limited, not only by the absence of such favourite molluscan haunts as reefs and rock-fringed pools but also by the

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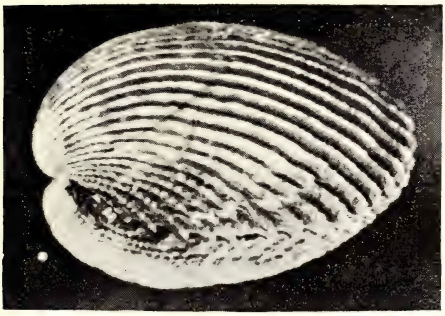
[1] The marine mollusca of Madras and the immediate neighbourhood. *J. Conchol.*, vol. 9, pp. 30-85 (1898).

restricted collecting area available between high and low water mark, the average rise and fall of the tide being under 3 feet with a maximum of 4.5 feet. Even so, a diligent search within wading depth will bring to light a fair range of species varying more or less regularly in seasonal rotation throughout the year. The most noticeable of these visitors is the lively tapering *Bullia vittata* (L.) with large water-charged foot and narrow and inadequate operculum which, with the rarer *B. livida* Reeve, may be seen in considerable numbers on the firm wet sand at low tide, particularly at Parry's Beach to the south of the harbour. This, on occasion, feeds on the little round-backed crab (*Philyra*) whose arrival synchronizes with that of *Bullia;* after an initial 'hand off', the crab submits to being seized without any further effort at resistance and is soon drawn within the muscular folds of the mantle. So determined is the hold on its victim that the *Bullia* can be pulled almost completely out of the shell without losing its grip. This mollusc dwells with us for several months each year, during which time its family increases and grows up rapidly. The shell of *B. livida,* although resembling that of *B. vittata* both in shape and design, except that the spiral band of tubercles below the sutures of the latter consists of two or three rows whereas in *B. livida* it is usually single, will be easily recognized by a richer colouring and thickened outer lip, in addition to which the operculum is squarely oval and more or less fills the aperture. *B. tranquebarica* (Röding) is a third local representative of this genus of the family *Nassariidae,* and its triangulate operculum with serrated edge completes the three types of operculum associated with this family.

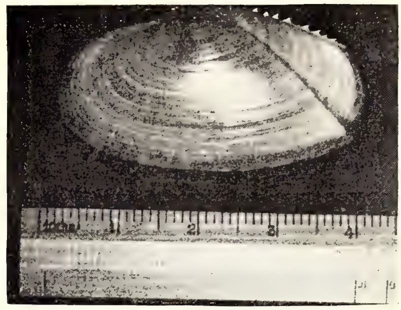
Farther south, at St. Thomé and beyond, olive-shells are to be found at all seasons, both *Oliva oliva* (L.) and *O. ispidula* (L.), the latter in an infinite variety of colours and markings. Early in February each year large colonies of *Oliva gibbosa* (Born), in mature form, are to be found for a brief season near the shore at Elliot's Beach, the raised ridges of their mole-like burrows in the sand indicating their position. This handsome shell attains a length of some 3 inches and bears a close resemblance to *O. nebulosa* Lam., both in pattern and colouring. The latter, however, is narrower with a more tapering spire. Unlike *O. gibbosa* it is very rarely taken near the shore although commonly dredged in from 6 to 10 fathoms in all stages of growth.

The Olives are also carnivorous and show a partiality for the shy little mole-crab (*Hippa asiatica* Edwards). I have more than once witnessed the unequal contest with the victim struggling valiantly but helpless in the pincers-like grip of *O. hispidula,* whilst the swift incoming waves have swept the pair several times up and along and down the gently sloping beach and finally into deeper water without being able to break them apart. One cannot help feeling a sympathy for this strange, gentle creature, known locally as 'eel-lee', which spends the entire day digging itself into the wet sand with feverish haste as each receding wave leaves the ill-protected little body exposed to the pounce of Brahminy Kites and crows ever on the look-out for the tasty morsel. Providence's only compensation would appear to be the allotment of a

MARINE SHELLS OF MADRAS.



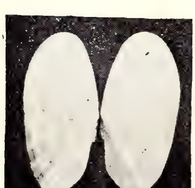
1. *Cardium assimile* Reeve.



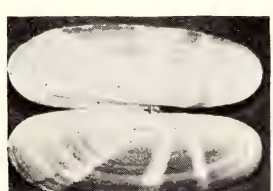
2. *Tellina foliacea* Lin.

3. *Tellina angulata* Gmelin. *Tellina timorensis* Lam.

4. *Cultellus maximus* (Gmelin).

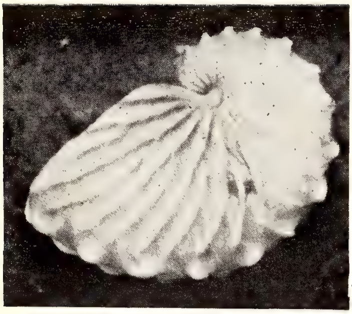


5. *Psammobia amethystus* Wood.

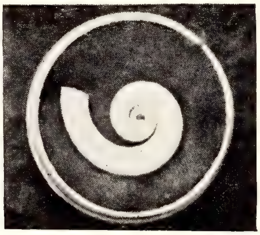


6. *Siliqua radiata* (Lin.).

MARINE SHELLS OF MADRAS.



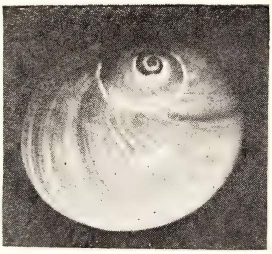
1. *Argonauta hians* (Solander).



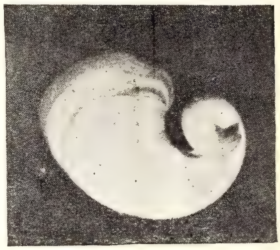
2. *Spirula spirula* (Lin.).

3. *Xenophora solaris* (Lin.).

4. *Natica lineata* (Rod.).

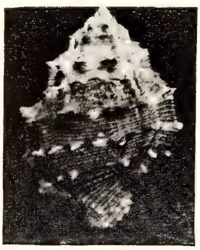


5. *N. didyma* (Rod.).
(normal shell).



6. *N. didyma* (Rod.).
var. with scalariform
whorls.

7. *Bursa spinosa* (Lam.).



8. *B. crumena* (Lam.).

9. *Gyrineum natator* (Bolten).

very brief span and its troubles, therefore, are soon over. Let us hope that under cover of darkness there may exist compensations of a more material kind !

Rapana bulbosa (Dillwyn) (Plate III, fig. 6) is sometimes swept shorewards during stormy weather and may be found clinging to an old shell or root of sea-weed, the young ones adhering to each other in clusters. *Nassarius* and *Natica* (Plate II, figs. 4, 5, 6) may also be taken.

Amongst the bivalves which feed near the shore are found four or five kinds of wedge-shell, the finest being the magnificent *Donax scortum* L., strongly fashioned with deep corrugations and rich purple interior. The tiny *D. dussumieri* Bertin may be found during brief periods about February and August each year. Large quantities of this brilliantly variegated little shell congregate an inch or so under the surface at ebb of tide; when exposed they quickly dive out of sight, sharp end first, into the wet sand. The commonest is *D. cuneatus* L. in a range of colouring, radiating from the umboes, which includes pale blue, yellow, brown, and a harsh liver-green. The young are in evidence in October in the shelter of Ennur backwater, while in February and March the half-grown and adult shells may be found together in large numbers between tide marks at St. Thomé and Ennur. In calm water the circular orifice of the upper or lower siphon may be observed just above the surface of the sand, indicating the presence of the shell buried an inch or so below. Fully grown shells measure from 40 to 43 mm. in length. Other all-the-year-round frequenters of the intertidal region include *Sunetta scripta* (L.), beautifully and variously patterned in purples, browns, mauves, gold, and ivory. These make their début about December and their growth may be followed month after month until the following autumn when they attain a full stature of some 33 mm. Several other brightly patterned species of the Venus family are also found.

Mactra cygnus Gm., whose thin but strongly formed shells, in a good range of colours, are usually to be found scattered on the beach, visits the shallows for a brief period only during the south-west monsoon, the young shells beginning to appear about April. *Mactra mera* Rv., *M. striatula* L., and young *M. turgida* Gm. are not uncommon towards the end of the north-east monsoon. The shells are seldom found complete, i.e. with both valves joined together or 'mudi' (முடி) as our young helpers concisely describe this desirable condition, unless taken alive.

Of the Garidae, *Soletellina diphos* (L.) should be looked for immediately south of the Adyar during the first violent storms of the north-east monsoon when it is dislodged from its sandy bed and flung ashore. Unless freshly collected the valves soon become separated, the thick greenish yellow periostracum cracks and peels away and the hot sun quickly bleaches the rich purple colouring of the shell. The young may be found earlier in the year in the extensive backwaters at Ennur and Covelong which are periodically open to the inflow of the sea.

The fan-oyster (*Pinna*) is another dweller in or near the channel of the Adyar river to seaward; live specimens are sometimes

uprooted from their burrows during the north-east gales. *Pinna* grows to a large size, *P. pectinata* L. (=*hanleyi* Rv.) and *P. attenuata* Rv. having both been found at Madras up to over one foot in length. A specimen of the latter, taken at Tuticorin, measures 19½ inches. A third species, *P. vexillum* Born, of dark colour and spreading shape and provided with a short, strong byssus, is occasionally delivered up during stormy weather a few miles farther south; mature shells of this species are of heavy, stout structure and are easily recognized. It may be remarked that the Madras *P. pectinata* does not, as a rule, show any external sign of the byssus, usually associated with *Pinna*, although, on close examination, two or three fine silken threads will be found issuing from the byssal opening immediately above the foot of the animal. It seems possible that these particular individuals, living in sand, without stones or other suitable anchorage available, had no use for a byssus. *Pinna* breeds about May or June to judge by a 20 mm. juvenile collected towards the end of June. *Siliqua radiata*, the sunset-shell, is very seldom taken alive or even with periostracum, but the spread-out empty valves, brilliantly rayed with blue and white, are abundant on the wet sands at ebb-tide.

Towards the end of the year, after a period of gales, large numbers of living *Pecten tranquebaricus* Gm. and *Pinctada chemnitzii* (Phil.) are sometimes washed ashore at Ennur.

Shore Collecting.

High-water mark throughout the year will reward the diligent seeker with a varying and fascinating harvest, chiefly of the smaller sort. There are many sharp little eyes at our service among the children of certain villages by the sea who have learnt to know what the *changu-dorai* wants and what he does not want. Amongst such helpers I remember with special gratitude Chinápen, Pichikaren, Sammykins and his sister Chinnapoo. From these high-tide gatherings could be named upwards of one hundred species, but a selection must suffice.

The gastropod Aglossates are well represented. Of these the brilliant *Pyramidella terebellum* (Müller), with deep-chestnut spiral bands, grows to a full inch. The genus *Turbonilla*, of the same family, is represented by five or six species, including the white *T. coromandelica* (Melv. & St.), growing to 21 mm. With the aid of a magnifying glass may be clearly seen the peculiar development of the shell, the spiral growth of which begins in a sinistral direction thereafter twisting at right angles and finally developing in a normal dextral manner. The allied family of Eulimidae is represented by polished shells of the genera *Eulima, Balcis,* and *Niso*. The last is represented by two species, one of which, *Niso pyramidelloides* Nevill, just over half an inch in height and recognizable by its double spiral band of rich chestnut-brown, is among Madras's loveliest shells. *Balcis* is of snow-white colour, a typical feature of many species being a graceful backward bend which is very noticeable in *B. martinii* (A. Ad.). *Eulima* is usually spirally banded with brown; the local species *E. bivittata* (H. & A.

Ad.) grows to about $\frac{3}{4}$ in. in height. Some Eulimids are parasitic on 'sea-cucumbers' to which they attach themselves so firmly that considerable force is required to dislodge them. These shells are washed up during the south-west currents between March and August each year.

Another attractive genus is the familiar wentletrap or *Epitonium,* of which a dozen or more species may be gathered during the same season; also two species of the little *Ringicula,* and the iridescent *Minolia impressa* (Nevill). These last three, and other small fry such as *Bullina, Pupa, Cylichna,* should be sought for amongst the scum and weeds of high-water mark on the seaward bend of the estuary at Ennur as well as in deep cracks in the water-sodden timbers of old catamarans.

The Scaphopoda are represented at Madras by two species of *Cadulus* and by six or seven of the well-known *Dentalium* or elephant's tusk-shell. Beach specimens of the latter are usually broken and should not be collected unless the posterior or smaller end is intact, the margin of the small opening being often notched on the convex side. In addition, several species are furnished with a small supplemental tube protruding from the apical end, easily broken. Besides the smooth forms, *D. octangulatum* Don. may be found with seven, eight, and nine main ribs. A six-ribbed shell of stout *octangulatum* form and one of 16 ribs, have still to be identified.

The Class Cephalopoda comprises creatures of the type of squid, octopus, etc., in which the shell is internal or absent. The calcareous 'cuttlefish bones' which litter our beaches at all times belong to *Sepia* and *Sepiella*. *Sepia prashadi* Winckworth whose pink-backed shells, up to 110 mm. in length, are to be found from January to early in April each year, has only recently been described. *Sepia andreanoides* Hoyle (*Doratosepion*) also occurs, measuring $2\frac{1}{4}$ inches, of similar colouring towards the spine but narrower in shape and with the dorsal longitudinal depressions undeveloped; rare here, it is common on Khor Maksar beach at Aden. *Loligo* is very common; a live individual must be secured in order to obtain a specimen of its transparent and perishable 'pen'.

The shells of the three external shell-bearing Cephalopods are also to be found at Madras. Those of the deep-sea *Spirula spirula* (L.) (Plate II, fig. 2) and of *Nautilus pompilius* L. are thrown up in stormy weather, the latter always in fragmentary condition. I once picked up a young Nautilus shell measuring 1 inch in length about eight miles south of Elliot's Beach and I have also found one *Argonauta hians* Sol. (Plate II, fig. 1) in what appears to be fresh condition. This indication of the presence of a Nautilid nursery off the Coromandel Coast must not be accepted too readily as these shells are very buoyant and may be brought to our shores from other parts by monsoonal currents.

The arrival of large numbers of the seed pods of *Carapa obovata,* also stated to be *C. moluccensis,* during the early months of each year when north-easterly winds have already been blowing for two or three months, may be cited as an instance of the carrying power of the winds and sea currents. The Carapa tree grows

in the tidal forests and mangrove swamps of Malaya, on the Aracan Coast of Upper Burma and, doubtless, in the Nicobars and Andamans and it seems likely that some of the pods which reach Madras may have come from the last-named place which is a known habitat of *Nautilus*. The nearest location of Carapa to Madras is fully 200 miles to the north, in the Guntur forest division, so that in any case the pods in question must have travelled by sea for a considerable distance.

The Carapa pods should be examined as they frequently harbour a nest of ship-worms (*Teredo*) which, as free-swimming fry, have attached themselves to the floating homes so conveniently offered and dug themselves in to such good purpose that during the long sea voyage they have developed and grown to full capacity, supplanting the kernel and filling the entire shell with a closely packed twist of their strange tubular casings. Inside these tubes will be found the palettes and shells of *Teredo clava* Gm. Similarly, waterlogged branches or pieces of timber often house *Martesia* and should not be passed by unchallenged.

Amongst the less common lamellibranchs should be recorded the watering-pot shell (*Brechites*), with aberrant valves which fail to function in a normal manner at an early age, the unhappy inhabitant thus being left to 'think again'. The result is an amazing travesty consisting of a cylindrical tube, 4 or 5 inches long, terminating at the lower extremity in a perforated convex shield surrounded by a frilled border of tubes branching out like the petals of a flower, the perforated centre being reminiscent of the rose of a watering-pot. An examination of the tube, immediately above the rose, will locate the useless bivalve shell embedded *in situ*. *Cucurbitula cymbium* (Spengler) is another lamellibranch whose shell is even more effectively disguised. *Cucurbitula* creates for its burrow a pear-shaped encasement, moulded of sand and shelly matter, generally attached to another shell or piece of loose coral wherein to pursue undisturbed its placid philosophy of life—*'non omnia possumus omnes'*.

The months of May to August, when southerly winds prevail, provide us with an interesting series of juveniles in the earlier stages of shell development, i.e. at the commencement of the enlargement of their homes from the embryo or veliger stage. A powerful magnifying glass is essential in order to be able to note and appreciate the delicate beauty of these embryonic shells.

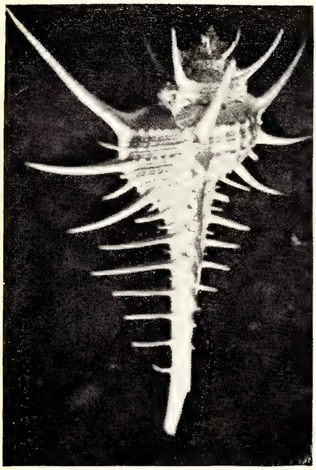
During the periods of storm, particularly in the autumn, Aviculids (Pteriidae) may be found still clinging to the branches of sea-fans which have been torn from the ocean bed, the shells varying in tone between yellow and red according to the colour of the particular Gorgoniid adopted for their life-long dwelling place. At these times some of the larger worn and broken shells which are washed ashore, such as *Ficus*, (Plate III, figs. 1 and 2) *Turritella*, etc., usually contain a family of the flat slipper limpet, *Crepidula walshii* Herrm., as many as a dozen often being crowded together into a wholly inadequate space, the neat circular baby shells clinging to the backs of their elders. The apices of the young shells show clearly the original spiral formation. It is advisable to boil these

MARINE SHELLS OF MADRAS.

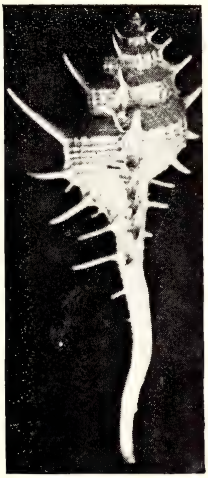
1. *Ficus graciis* (Sow.).

2. *F. ficus* (Lin.).

3. *Thais rudolphi* Lam.



4. *Murex tribulus* Lin.



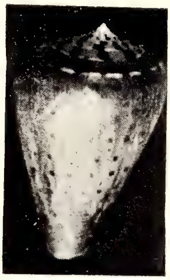
5. *M. trapa* Rod.

6. *Rapana bulbosa* (Dill.).

7. *Xancus pyrum* (Lin.).
Height 9.2″; diameter 5.2″.

MARINE SHELLS OF MADRAS.

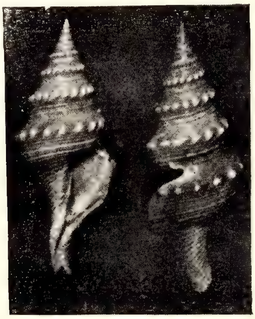
1. *Conus textile* Lin.



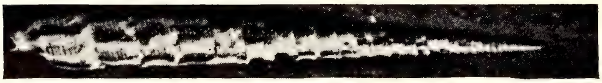
2. *C. betulinus* Lin.

3. *C. amadis* Lin.

4. *Turris indica* Rod.

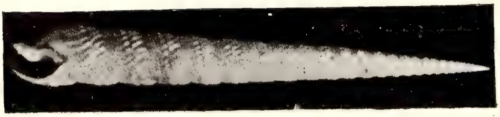


5. *Turricula javana* (Lin.).



6. *Terebera commaculata* (Gmel.).

7. *T. duplicata* L.



8. *T. anilis* (Rod.).

out in order to avoid damaging the delicate edge of the inner plate. Colonies of *Crucibulum extinctorium* auct., a close relative of *Crepidula* but of a limpet or cup-like shape and with the inner plate formed into a twisted poke or cone, are also often to be found adhering to the outer surface of dead or living shells. This possesses a clearly recurved apex which, however, is usually blunted or worn away. The shell varies greatly in shape according to its environment and not infrequently bears a coloured spiral decoration; it may also show a grooved or striated pattern impressed from the sculptured surface of the shell on which it has grown.

No record of the shells of the shore should omit mention of that sapphire harvest of the monsoon when the violet sea snails (*Ianthinidae*) are cast ashore, sometimes in prodigious numbers and still alive with their efficient floats attached, the delicate shells flung from the crests of the crashing waves and seldom suffering hurt because of their lightness and buoyancy. It requires several days of strong onshore winds to bring them from their ocean base and—this is important—one must be present when the miracle takes place; by next day the wind will have scattered the shells far and wide and scarcely a trace will remain. The two commoner species of *Ianthina* which visit Madras are of very distinctive forms. *I. roseola* Rv. is squat in shape, the aperture three-quarters square and the shell of a heavier and stronger structure than *I. iricolor* Rv., whose larger aperture extends to a point at the base and has an outer lip of cupid's bow shape. The latter is seldom seen, although in March, 1939, I witnessed a large influx of them in all stages of growth from 5 mm. up to 35 mm. in height, many of the larger size having closely arranged egg-pouches, of a pale mauve colour, hanging from the underside of the float.

In spite of their enforced migration, a highly efficient organization manifests itself by the presence of small jellyfishes (*Siphonophora*) which bear them company during the long voyage and upon which they feed. Many of these are also violet in tint or else a sea-green, examples being the thin circular *Porpita, Velella* with sail-like projection set diagonally across its raft, and the Portuguese man-o'-war (*Physalia*), all of which are invariably found on the shore in large numbers along with *Ianthina*. Young *Ianthina* sometimes drift to the shore in the early months of the year; even the tiniest of these, barely 2 mm. in height, is provided with its float several times the size of the shell. At the time of low tide the white, frothy appearance of the float bubbles and the brilliant blue shells sparkle in the sunshine on the smooth wet sand. At similar seasons, and apparently forming a unit of the flotilla, may also be found the acrobatic little *Glaucus marinus* (Du Pont)—but this is a shell-less mollusc and therefore outside the scope of these notes.

The Fishing-Nets

It is worth while to be at hand when the great seine nets or *periyavalai*, taken a mile or so out to sea by Masula boat, are hauled in to shore. These frequently provide something new or desirable if one is quick enough, and lucky enough, not to miss

the prize as it slides elusively out of sight to be lost irremediably in the mass of soft palpitating bodies of fishes of all shapes and sizes, cuttles, medusae, crabs, and sea-snakes which are brought in with each haul. Incidentally, the collector would be well advised not to stand in the sea in the vicinity of the jellyfish which have to be cast out of the nets particularly during March and April. The slightest contact will set up a painful irritation and the affected part should immediately be rubbed down with sand and sea-water. A local cure is the application of tamarind paste. The villagers' name for jellyfish is *sori,* meaning itching. By means of these nets and particularly from a similar but smaller type of net known as *turi* which is used for ground trawling, being operated from two catamarans out to sea, many of our larger shells, usually in living condition, may be secured. I here mention some of these without adopting any particular order.

Harpa conoidalis Lam. is the sole representative of the family Harpidae. The shell is sturdy, richly decorated, and gloriously polished within. The inhabitant, at any effort to draw it forth, detaches the hinder and deeper coloured portion of its foot, which is left in one's hand in a most disconcerting way, much as the gecko with its tail. This solid fleshy attachment is fitted into a groove running along the posterior edge of the foot proper and comes away with very little pressure, leaving a clean undamaged socket which reminds one of the spring-back binding of a certain type of loose-leaf album. The amputation can be, and is, performed without adventitious aid, as occurred with a fully grown specimen which was being kept under observation in a bowl of sea-water; this individual climbed over the edge of the bowl and tumbled out leaving the lobular appendage behind. On another occasion this part detached itself and fell to the ground when a specimen was being transferred from one bucket to another, the shell being held mouth downwards and without any contact with the inmate. My largest specimen of this shell, collected at Madras, measures 95 mm. in height and 68 mm. in diameter.

The Conidae, with narrow operculum which is not always easy to locate, provide at least half-a-dozen species. *C. figulinus* L. is the common form with thick brown shell, but *Conus amadis* L. (Plate IV, fig. 3) is of outstanding beauty both in colour and brilliance of polish, varying considerably in design and fairly plentiful. *C. betulinus* L., (Plate IV, fig. 2) with thick periostracum and decorated with rows of dark brown spots, is of massive proportions and grows to above 4 inches in height, with a circumference of twice that measurement. My largest specimen measures 110 mm. in height.

The Ficidae or fig-shells number three species, all of them with delicately graved reticulate pattern and thin outer lip whose fragile edge, in the growing shell, requires the greatest care in cleaning to avoid chipping.

The Muricidae are well represented, many being provided with formidable defence works such as *Murex virgineus* (Röding), with mouth edged with coral pink and the spiny *M. tribulus* L. (Plate III, fig. 4). Some *tribulus* develop a distinctive

sculpture, the main feature of which is the number of transverse ridges between each of the major spines which varies from five to eight instead of the usual three. In addition the tubercles on the body-whorls of the former are closer set and more numerous; until young specimens of the former type have been found it must be assumed that the variation is merely a late development of the same species. *M. trapa* Roding (Plate III, fig. 5), a third variety of the type found at Madras is distinguished by its elongate spire but, particularly, by a prominent denticle in the anterior portion of the outer lip which can be traced back in the varices to the earliest whorls of the shell. The delicate *Murex pinnatus* Swainson, with feathery fin-like varices, is also worthy of special mention.

Cymatiidae, of which some half-a-dozen species may be secured, are of strangely irregular shape and furnished with fringes of strong bristle-like hairs along the crests of the varices.

The Tonnidae are represented by four species of which *Tonna dolium* (L.) = *maculata* (Lam.) comes ashore in large numbers. The protoconch is a tiny, smooth, amber-coloured spiral globe and bears no resemblance to the developed shell, but will be readily recognized by an examination of the apex of a mature specimen. A series of this shell showing the different stages of growth, the thickening and strengthening of the shell and the development and final fading away of the colour pattern as the supply of pigment becomes inadequate for the adornment of the expanded surface, can easily be formed. This method of collecting might, indeed, be applied to many of the spiral shells to add an instructive interest to the collection.

Amongst the Pectinidae is the beautiful *Amusium pleuronectes* (L.), known as the 'sun and moon shell', with the left or upper valve of livid hue and the other a dead white. This lamellibranch gets caught up in the nets a few miles south of Elliot's Beach, off Tiruavamoor, the adults arriving early in February, apparently for spawning as the spat and growing shells are in evidence from early March until June. Full-grown specimens measure up to 83 mm. both in length and height. *Amusium,* in common with other members of the Pectinidae, is active in its movements and, if placed in a large basin of sea-water may be seen to dart about with an amazing quickness of action. The animal is provided with a hundred or so eyes of different sizes, round and staring like those of a doll, which are placed at odd intervals among the waving filaments which fringe the edge of the upper mantle just inside the rim of the shell. I have counted up to 106 such eyes in one individual. *P. pyxidatus* (Born) has about 30 and *P. tranquebaricus* Gm. upwards of 50 eyes fringing both mantles to the auricle extremities.

Madras can claim about forty species of the family Veneridae among which three *Paphia,* commonly brought in from the deeper sea during the latter months of the year, deserve special mention by reason of their colouring and brilliant sheen, namely *P. alapapilionis* Röding (85 mm.), *P. textile* (Gm.) (66 mm.), and *P. gallus* (Gm.), also known as *P. malabarica* (57 mm.); the

measurements given in brackets are the lengths of the largest specimens so far collected by the writer. Several specimens of *P. undulata* (Born), distinguishable from *textile* by well marked, irregular, concentric ridges, have been found recently after a lapse of many years. Similar occurrences of the intermittent appearance of a particular species, after an apparent interval of years, are evident from time to time; a further example may be cited this year (1940) in the case of *Xenophora solaris* (L.) (Plate II, fig. 3), sixteen live specimens having been brought up in the catamaran drag nets during the month of July although no specimens had been recorded during the past five years.

Mactridae, too, are plentiful, amongst which *Mactra turgida* Gm., swollen out as its name implies and with umboes violet-tinged, is notable for its size, as is also the gaping *Cultellus maximus* (Gm.) (Plate I, fig. 4), of the Solenidae, which exceeds 5 inches in length.

Volva sowerbyana (Weink.), a small relative of the *Cypraeidae*, is rarely taken in live condition. The mantle fringe is dotted with bright spots of deep orange colour and the shell itself has an attractive sheen which, however, soon wears off.

Hydatina velum (Gm.), light as a bubble and measuring up to 46 mm. in height and 4 inches in circumference, is brought to shore in fair numbers about July and again towards the end of the year. To see the animal fully exserted and expanded, with frills and flounces most attractively fringed with purple, fills one with amazement that so much can come out of so little. To tuck itself in again requires delicate adjustment and takes time.

The true *Cassis* is not known at Madras but there are four species of the genus *Phalium*. These have brightly decorated shells, particularly *Phalium areola* (L.). *P. glaucum* (L.) has also a very handsome shell which grows to 4 inches or more in height. The animal is beautifully coloured in orange, brown, etc., the mantle being bordered with a brown edge. This is capable of expelling a purple fluid which will soon discolour a bucket of water.

Of the Strombidae, which are well represented in the Gulf of Manaar, four species have found their way as far north as Madras; *Strombus succinctus* L., whose shells, with expanding outer lip and measuring about 2 inches in height, are very occasionally brought in. These are invariably tenanted by hermit crabs, no living specimen having so far been taken. The young shells up to ¾ in. are not infrequently found on the shore. Madras's other Strombs are *S. sibbaldii* Sow., (?) *S. vittatus* L., and *Rimella cancellata* (Lam.), a most attractive little shell of about 1 inch.

A few miles south is located the local chank bed, to judge by the number of *Xancus pyrum* (L.) (Plate III, fig. 7), brought in. These are of the Tanjore tribe, fully turbinate and with flesh-tone colouring within. A large specimen, taken in a fisherman's net off Warikuppam, the village immediately south of Elliot's Beach, measures 9¼ inches in height and 15½ inches in circumference, and weighs 2½ lbs. This is a truly handsome shell although not so highly prized for the bangle industry as the purer white and more spindle-shaped *X. rapa* (Lam.) of Tuticorin. Young shells of both

these species are as a rule brightly decorated with closely set rows of brown spots. The egg-case of this mollusc is occasionally washed up during the early part of the year, in shape reminiscent of a goat's horn, with numerous segmental divisions stuffed with embryonic shells. The nipple-like protoconch persists in the full-grown shell as also in *Tudicla spirillus* (L.), of the same family, which is also found in this locality.

Few collectors can boast the possession of a sinistral chank. This well-known variety commands fancy prices partly on account of its scarcity but chiefly because it possesses a religious significance in Hinduism and Buddhism, which ensures a keen demand locally at all times. At long intervals one of these desiderata comes on to the market, the price realized for a medium-sized specimen being usually about Rs. 500 to Rs. 800, although much higher sums have been paid. Unfortunately there is no record of the number of sinistral chanks taken off the east coast of India, the Tanjore Chank Fishing-rights having been leased out by Government to contractors except for two or three seasons only when it was worked departmentally. During these years, out of a total catch of 57,324 shells, there is no record of a sinistral chank having been taken. The Tinnevelly Chank Fishery at Tuticorin has remained under strict Government control for many years. The records in this Department show that only two sinistral, or *valampuri* (meaning 'right twist') chanks were taken during the twenty-four years from 1914—one in 1930 and one in 1937—out of a total annual catch which, in recent years, has averaged between 300,000 and 400,000 shells. The fortunate diver who brings in a specimen receives a reward of one thousand times the price of a normal shell, which, at the present rate of one anna per shell, would amount to Rs. 62-8 as. From what I can gather it would appear that the sinistral variety of *X. rapa* of the Gulf of Manaar is much scarcer than that of *X. pyrum*, the Tanjore or Madras species.

The only other freak sinistral shell that I have seen from South Indian waters was a specimen of *Marginella angustata* Sowerby. Two species of *Triphora* in which the sinistral condition is normal may be found at Madras.

Many minor freak formations may be found such as in *Murex tribulus* L. (Plate III, fig. 4), whose normally straight canal is sometimes sinuous or twisted, and *Natica didyma* (Röding) (Plate II, fig. 5) with scalariform whorls. *Thais bufo* (Lam.) develops a remarkable thickening of the columellar lip which may even engulf the apex of the shell and was made a separate species by Lamarck under the name *callosa*. In another category are the malformations due, for the most part, to some early fracture and subsequent repair which has interrupted the orderly growth of the shell or disturbed the normal position of the varices or other processes, such as occur in *Murex* and *Volema*. From a similar cause damage to the mantle may affect the supply of pigment resulting in the colour-pattern of the shell changing or even vanishing altogether. I have examples of these in *Natica alapapilionis* (Röding) and *Tonna dolium* (L.). Albinism is of frequent occurrence amongst some of the brightly coloured bivalves such as Tellinidae as well as in

certain gastropods, for example *Drillia crenularis* (Lam.) and *Turricula tornata* (Dillwyn). I have also seen a striking example in *Conus amadis* Gm., which normally boasts a resplendent coat of brown and gold.

Our only Volute is *Cymbium*, the melon-shell, which grows to nearly a foot in height and twice this measurement in circumference. The animal wears a handsome mantle decorated with yellow and dark-brown stripes, depicted on the shell in the earlier stages of growth, while the interior of the shell has a beautiful satiny sheen. These are fairly plentiful, particularly towards the end of the year.

The best collecting period from the nets is from December to February when the mature molluscs apparently return each year to their spawning grounds in the shallower depths reached by the smaller trawling nets, say, perhaps, of 10 to 15 fathoms.

Dredging.

To explore with a dredge the sea bed of Royapuram Bay, and such depths as can be dragged by hand from a small boat yields a rich harvest of various dwellers in mud and sand.

With the first haul one is almost certain to see *Babylonia spirata* (L.), a powerfully built mollusc which, when dropped into the Kilner jar, immediately begins to throw its weight about in its endeavour to force an escape, much to the discomfiture of its fellow-captives. The aperture of the shell is usually of a highly glazed porcellanous white but a variation also exists in which the mouth and columella area are coloured a fulvous yellow. The two varieties are very distinct. Furthermore, the shell normally has a deeply excavated umbilical opening but specimens are not uncommon where the lower part of the columellar lip has folded backwards and spread over this opening until the umbilicus is completely obscured. The mature shell is generally about 2 inches in height but specimens are found exceeding 2½ inches. *B. zeylanica* (Brug.), a scarcer member of the family, is remarkable for the bright violet colouring within the umbilical opening of the shell and the two richly coloured red-brown bands which decorate the upper side of the leaf-shaped foot of the animal.

Several species of *Mitra*, including *Vexillum*, and of *Cancellaria* will be found as well as the very striking staircase-shell, *Architectonica*, with its variations in design, its brightly coloured decorations and peculiar pegged operculum.

Volema pugilina (Born), one of the largest shells of the coast, is obtainable here and, at the other extreme as regards size, *Phacoides macassari* (Prashad), a tiny spherical bivalve of extraordinarily deep sculpture, which barely fills the 5 millimeter gauge in any direction.

The Conidae and Terebridae, of the tribe Toxoglossa, whose members are provided with a poison-gland, occupy an important place amongst the Madras mollusca. In addition to the Coninae, whose sole genus *Conus* (Plate IV, figs. 1, 2, and 3) we have already noted, the Conidae family is divided into the sub-families

Brachytominae, Cytharinae, and Turrinae, the shells having a sinus or slit at the upper end of the labrum which at one time earned for them the descriptive group-name of Pleurotomatidae. Madras can claim over fifty species of these 'silt-lips', many of them obtainable by dredge.

The local Terebridae, numbering some eighteen species (Plate IV, figs. 6, 7, and 8), display considerable diversity in design and colour pattern. In size they vary from the ½ in. *Terebra tenera* Hinds, to a height of close upon 5 inches in *T. commaculata* (Gm.) (Plate IV, fig. 6). Many of these are fairly plentiful at a depth of from 15 to 20 fathoms, both out from the harbour and farther south. *T. triseriata* Gray, remarkable alike for its attenuated form and delicate sculpture, is one of the scarcest of the Madras shells whereas *T. eximia* Dh., reputedly a shell of some rarity, apparently pays seasonal visits to Madras waters a few miles south of Elliot's Beach, the empty shells, in fairly fresh condition, but generally with a hermit crab in possession, being not infrequently brought up in the fishing-nets during the north-east monsoon season. There are two varieties of *T. eximia* with three and four narrow bands respectively between the main spiral bands. No living specimen has yet been taken locally and my efforts to locate their place of settlement have resulted only in the capture of a dead specimen obtained at a depth of 15 fathoms. The shells measure up to slightly over 2½ inches in height.

Marginella ventricosa Fischer with deep olive-green shell which soon fades to a dove grey on exposure to the air, is a gem which should be preserved as long as possible in the home aquarium in order to mark the bejewelled decoration of mantle and tentacles. *M. angustata* Sowerby, of brilliant polish, is plentiful in all stages of growth.

Philine is an interesting creature, to outward appearance a lump of white, rather solid, jelly. Careful dissection is necessary here in order to expose, without fracture, the gossamer-thin shell within and the gizzard plates which are so well fitted for crunching the shells of smaller mollusca for food. It may happen that a tiny shell is actually in place for cracking at the moment of capture. *Sinum*, a relative of *Natica*, also has the shell hidden within the flesh and likewise requires delicate handling. *Ancilla* is unable to retire wholly within its smooth ivory-like shell but in this respect cannot be compared with the internal shells of *Philine* and *Sinum*.

Arcidae are in abundance and in varied forms which include the hirsute *Barbatia*, the strange twisted *Trisidos tortuosa* L. and, in the mud deposit off the East Quay, at a depth of 6 fathoms, *Cucullaea concamera* (Brug.), which is provided with a cup-like compartment in each valve for the attachment of the anterior adductor muscle. *Glycymeris*, a relative of *Arca*, is also plentiful.

The nut-shell (*Nucula*) with nacreous interior and the tiny *Nuculana*, whose shells are never to be found on the shore in fresh condition, are obtainable in Royapuram Bay in 6 to 8 fathoms. Two varieties of *Nucula* are common, one with smooth rims and the other with the interior of the margins finely serrated. *Aloidis*, better known by its synonym *Corbula*, with misfit valve, is another of

the smaller lamellibranchs, several species of which will be taken from the same fishing-ground.

Tellinidae are well represented, also cockles [*Cardium* (Plate I, fig. 1) and *Cardita*], the razor-fish (*Ensis*), *Cultellus* (Plate I, fig. 4), and *Pandora*. *Cardium asiaticum* Brug., odd valves of which are common on the beach, in live condition has the radiating ridges set with sharp-pointed spines and delicate laminae which are absent in beach specimens.

Among the sea-urchins there are two species, *Temnopleurus toreumaticus* and *Salmacis rubricincta* (?), which play host respectively to species of *Eulima* and *Stylifer*, whose minute shells may be found attached between the spines. The Holothurians or sea-cucumbers should not be thrown back without inspection. If the long-fingered starfish, *Linckia*, should make its appearance it should be searched carefully for a small Capulid of the genus *Thyca*, though I must confess that it has so far eluded me.

The Harbour.

Residents of Madras may be surprised to learn that upwards of fifty different species live in the harbour, some preferring a site to seaward although battered constantly by the waves, others choosing the tranquil waters within.

The harbour floor consists of a slimy, soft mud which is practically devoid of mollusc life with the exception of very occasional specimens of *Pandora*, *Paphia*, and *Cancellaria*, which can be obtained under pleasanter conditions out to sea. The large buoys or ships' moorings in the centre of the harbour are also disappointing, being overcrowded by *Mytilus viridis* L. to the exclusion of aught else. The collector is recommended to steer his boat to the inner quay on the northern side where good 'bags' can be secured amongst the submerged agglomeration of seaweeds, sponges, hydroids, and other sea-growths rooted to the wooden piles. The Lamellibranchia are almost exclusively of the fixed type, that is either cemented to the piles or to each other, or anchored by a byssus. Amongst the former are the massive *Chama* and *Spondylus* whose rough surfaces often bear strong outgrowing spines, the interiors being flushed with purple-rose. Of the byssus-forming mollusca a fairly representative collection can be formed, amongst which will be counted three or four species of Arcidae, of which *Arca lateralis* Rv. develops an interior plate or shelf-like septum although not so pronounced as in the case of *Cucullaea concamera*. Others are the oysters and mussels including the allied forms *Anomia*, *Septifer*, *Malleus*, and *Isognomon*, the last with a hinge reminiscent of a 'zip' fastener. *Lima lima* (L.), whose fringe of red and white filaments in constant motion is fascinating to watch, is provided with a beautiful pure white laminated shell.

The Gastropoda are about equal to the bivalves in numbers. *Euchelus asper* (Gm.) with rounded whorls, a Trochid of solid mother-o'-pearl, flourishes in large numbers throughout the year along with the flattened and sharply ridged sub-variety *tricarinata*. *Gyrineum natator* (Röding) (Plate II, fig. 9), a neatly sculptured

Cymatiid shell attaining a height of at least 2 inches, will also be found in abundance, particularly during the early months of the year. Species of *Engina, Pyrene, Drupa,* and *Thais* (Plate III, fig. 3) also live here.

Of the dozen species of cowry known to Madras, three at least make their homes here, viz. *Cypraea arabica* L., *C. pallida* Gray, and *C. ocellata* L. The last-named, decorated with brightly coloured ocelli, is a brilliant shell which it would be difficult to recognize in beach-worn specimens. Others attracted to this rich pasturage include the keyhole limpet, *Diodora lima* (Sow.) and the scarcer *Amalthea tricarinata* (Gm.). The latter challenges close scrutiny, being almost indistinguishable in its brown jacket, clinging limpet-like to a pearl oyster or gigantic mussel.

During the cold-weather months of 1938-9, large numbers of the small limpet-shaped brachiopod *Discinisca indica* Dall appeared. At low tide in the same area a Chiton should be looked for just above the sea level. This belongs to the genus *Acanthochitona* and may exceed 1 inch in length. It can be recognized by the tufts of strong bristles (eighteen in number) which decorate the margin or girdle. Numerous specimens of *Cypraea arabica,* already found on the piles, some reaching a basal measurement of 3 inches, and an occasional immature shell will also be found at low water, lurking in the deep fissures in the north wall which is also the home of *Mitra caeligena* Rv.

Higher up on the harbour wall, near and above the sea mark, are to be found *Littorina undulata* (L.), in vast quantities, of varied pattern and colour, and the local *Planaxis sulcatus* (Born) which is smaller than the Pamban and Tuticorin shell. A *Siphonaria,* that strange pulmonate of limpet form, will also be found here and the true limpet, *Patella* (*Cellana*).

The limpets, of which there are two or, possibly, three species, and several species of *Thais* thrive on the rocks outside the harbour walls where the boisterous and unexpected wave rejoices to catch the unwary mortal. Small chitons, *Plaxiphora indica* Thiele, may be taken clinging to the barnacle-roughened walls or lying closely hidden under the sea moss which covers the submerged concrete blocks of the breakwaters. This moss also provides cover for the dainty little *Pyrene terpsichore* (Sow.). *Venerupis macrophylla* Dh. should be looked for in chinks in the rocks where it lies securely wedged, although at times also found among the algae.

An opportunity should be watched for to explore the pools at the base of the blocks of concrete piled up in the fork at the northern end of the East Quay. Suitable conditions of low tide, combined with a westerly wind to check the incoming swell, will be met with during July. This exclusive site possesses a distinctive fauna which includes several mollusca not to be found elsewhere at Madras. Pride of place must be given to a large colony of *Turbo argyrostoma* L. clinging to the outer rocks at or just below sea-level; these are in such numbers that a handful of three or four at a time can be gathered. *Nerita albicilla* L. and *Nerita chamaeleon* L. will be noticed higher up on the rocks. Nerites have the nocturnal wandering habits of land-snails and are best collected

after dark, but the seeker by torchlight will find his task no easy one in this rough patch of country. It is strange that the shells of *Turbo* and *Nerita* are never found on the Madras shore, but this may be accounted for by the viscid nature of the soft mud of the harbour channel into which any old or dead shells must fall and sink deeply.

At one point occurs an unsuspected crop of coral (*Pocillopora*) within the thick stems of which will be discovered specimens of *Gastrochaena* and *Lithophaga;* in another pool a densely rooted seaweed furnishes a secluded retreat for *Arca avellana* Lam. Groups of a tiny *Arca symmetrica* Rv. will be found nested together in the hollowed undersurface of submerged stones. Numbers of the richly coloured *Thais rudolphi* Lam (Plate III, fig. 3), congregate at the head of narrow fissures in the rocks while *Thais intermedia* Kiener (=*hippocastanum* auct.) and two or three species of *Drupa,* and other rock climbers noticed elsewhere, are plentifully represented.

Cypraea arabica is particularly abundant, three distinct forms of the shell being present; two with dorsum of the flattened shape usual to Madras, one narrow and the other broad, the ratio of width to height ranging from ·54 to ·69, and a third with humped back sometimes separated as *histrio* Gm.

A straying *Bursa granularis* (Röding) or *Murex torrefactus* Sow. is indicative of other desirable things which may be clinging to the underside of the rocks deep in the sea. How to get at them is the problem ! Here, if anywhere, should be the haunt of *Haliotis* if an unconfirmed report that it has actually been taken at Madras is true.

The rock-oyster (*Ostrea forskalii* Gm.) will be noticed growing thickly at about tide level both inside and outside the harbour. A hammer and chisel will be found necessary in order to obtain a complete specimen. The empty valves adhering to the walls and rocks offer a favourite resting place to the small *Nerita* already mentioned.

The end of the projecting South Wall provides a swarming ground for countless numbers of small Littorinidae, particularly *Littorina malaccana* Ph. and *Littorina ventricosa* Ph., as well as a tiny reddish-brown *Assiminea* (?) which spreads like a fine gravel over the spray-drenched areas.

The Backwaters.

In the backwaters at Ennur, as well as in the Adyar basin, will be found representatives of several genera which, although at home under brackish conditions, are so closely connected with the sea as to justify inclusion amongst their purely marine kindred.

Of such are several of the *Tellinidae,* including the blood-red *Tellina cuspis* Hanley (at times, but rarely, a shining white), *Neritina,* fluviatile forms of *Nassarius, Cerithidea,* and the brightly and variously coloured button shells, *Umbonium vestiarium* (L.), which are fully grown about April-May. In their turn some sea-dwellers find their way into this territory for feeding and breeding

purposes. These include several species of *Arca*, a small cockle, oysters, *Donax, Volema, Oliva,* and *Natica;* the egg-ribbon of *Natica* is in evidence from April onwards. Other marine molluscs to be taken here include *Turritella duplicata* (L.), *Conus figulinus* L., *Paphia gallus* (Gm.), and the diminutive *Nuculana mauritiana* (Sow.). The last group may be regarded as chance visitors swept in by the tide before the closing of the sea channel; nevertheless they accommodate themselves to the changed conditions in which they find themselves and appear to thrive. This is particularly the case at Ennur where the wide channel admits a free inflow of the sea during the greater part of the year. In April or May, shortly after the banking sand has closed the entrance, many imprisoned molluscs may be collected. These instinctively make their way in the direction of the sea and will be found in the shallowing end of the closed channel or stranded on the wet sand and mud exposed by the sinking water. Mature specimens of the brightly coloured *Bursa crumena* (Lam.) (Plate II, fig. 8) and *Tonna dolium* (L.) are usually in evidence. It was here that I obtained my largest *Rapana bulbosa* (Dillwyn) (Plate III, fig. 6) measuring $3\frac{1}{2}''$ in height. This will also be an opportunity for collecting *Pinna pectinata* L. which ordinarily is difficult to locate in the deeper and swiftly flowing waters of the open channel.

In these peaceful retreats the sea-hare pursues its quiet way. *Aplysia fimbriata* (Ad. & Rv., which is the form commonly to be found at Ennur, exceeds 7 inches in length, its heavy, lumpy body being mottled with patches of grey and a dull sage-green, the darker shadings bearing a distinctive mosaic pattern. The Adyar sea-hare, probably a form of *Aplysia tigrina* Rang, with hood and mantle-folds richly ornamented in a close-set intertwining or maze-like pattern of bright olive-green on a grey background, is a gorgeous creature of leisurely movement whose general appearance conveys an impression of a prosperous and well ordered life. The internal 'shell' or shield of *Aplysia* is a transparent membranaceous affair measuring upwards of 2 inches in height and rather less across; the Ennur species has a more sloping shoulder than the other. *Bursatella,* sometimes misnamed *Notarchus,* adorned with jewel-like ocelli and variously coloured in deep brown, grey, or a bright golden-rust, is a close relative of *Aplysia* and makes its appearance in large numbers during the spawning season both in the Adyar and at Ennur. A microscopic spiral shell of nautiloid contour is present in the embryo.

At this season, in February and March, the weed-grown shallows will be found to be teeming with life in a wide variety of forms. Particularly so is this the case in the Adyar waters. The ubiquitous *Cerithidea cingulata* (Gm.) will be observed browsing in this rich feeding-ground and in the mud at the roots of the mossy weeds there may be collected a fair range of gapers, including several varieties of *Laternula,* whose paper-like, hyaline shells of a frosted whiteness require the greatest care in handling. These carry a fracture-like scar traversing both umbos but should not be discarded on this account, the condition apparently being normal. *Standella pellucida* (Gm.) is also present, its lurking-place revealed by the

attenuated siphon which protrudes 4 or 5 inches from the mud.

Periodically, with each spawning, the sea-grass and weeds will be found crowded with myriads of the small *Finella virgata* (Phil.) which reach a 'fledgling' stage in the course of two or three weeks and suddenly and mysteriously disappear. In the same way swarms of juvenile *Natica, Umbonium,* and *Nassarius,* may be noticed shortly after hatching, at odd times in different pools, throughout this period. These also quickly achieve a state of independence and disappear suddenly but are later easily retrieved from the river mud and sand at a depth of from 4 to 8 inches. The sea-grass harbours also the jewel-like *Smaragdia oualaniensis* (Lesson) and *Neritina siquijorensis* Récluz, both attractively adorned with variegated mosaic-like patterns. *Neritina* should also be looked for adhering to the inside of an old oyster or other shell and on stones in the Adyar above Elphinstone Bridge. On mud-covered bricks and bits of masonry lying in the edge of the water at the S.-E. corner of the Adyar pool may be found *Cyclostrema bushi* Dautzenberg and Fischer, besides two species of *Assiminea* and the small *Modiolus undulatus* (Dunker). Young oysters, both *Ostrea madrasensis* Preston and *O. forskalii* Gm., may also be noticed in large numbers astride the shells of *Cerithidea cingulata*, to which particular species they show a remarkable constancy, inevitably to become an embarrassment to both parties as the newcomer quickly outgrows its allotment. These top-heavy shells are often tenanted by hermit-crabs which soon become figures of misery as they stagger about under the increasing burdens which they have to bear until they are no longer able to join their more nimble brethren at the feast among the tender tips of the growing weeds.

At Ennur the larger Arcidae and *Telescopium telescopium* (L.), a ponderous Potamidid of 5 inches, the interior of which is smoothed over with a thick layer of plum coloured enamel, are fairly common in the soft exposed mud. The latter are particularly plentiful in the northern reaches of the backwaters at Covelong where the black mud acquires a slimy consistency to its liking.

A number of other species can be gleaned from the sand and mud with the aid of a sieve. In this manner we have secured at Ennur specimens of the lively little razor-shell, *Neosolen aquaedulcioris* Ghosh, and both at Ennur and Adyar several species of *Nassarius* and *Tellina*, which lie closely hidden a few inches below the surface of the mud, the familiar window-pane oyster (*Placenta placenta*), some of the smaller Trochidae such as *Euchelus* and *Minolia*, and the ½ in. *Odostomia attenuata* (A. Ad.) in amazing quantities considering that the empty shell is of the rarest occurrence. This last is seldom seen alive on the surface. Its method of progression is laborious, first advancing the small blood-red foot about a millimetre at a time, taking a grip on the sand and then hauling the shell along, repeating the process with a distinct pause at each stage of the completed movement in what can only be described as a furtive manner.

During the dry-weather months of March to May each year

the exposed surfaces of the sand-banks of the Adyar are scattered over with the thick shells of the popular edible 'mat-tee' (*Meretrix casta*) and other clams belonging to the Venus family. The empty valves of *Sanguinolaria* and the small slender *Solen annandalei* should also be looked for at the same time. The latter runs from barely 1 inch in length early in February to fully 3 inches in July. These bear a general resemblance to a broader and stoutly formed 4-inch shell, possibly *Solen lamarckii* Deshayes, which is brought in from the sea between August and October, young specimens in January/February.

Still later, in the months immediately preceding the south-west monsoon, a visit to Ennur will reward the collector with a very fair series of *Littorina*, both *L. scabra* (L.), whose colour-phases range over a choice of shades in yellow, brown, purple, and red, and the more attenuated *L. melanostoma* Gray, which may be gathered from the little white mangroves and marsh herbs of the muddy flats.

One should not omit to record the brachiopod *Lingula* which is to be found deep in the mud at the St. Thomé end of the Adyar basin. The brilliant colouring and sheen, the swivel-action of the hinge and the cilia in constant movement combine to make it a most fascinating creature to watch.

I should like to express my appreciation of the assistance so readily given at all times by the Museum and the Fisheries Department authorities in Madras as well as by Mr. R. Winckworth, of London, to whom I am also indebted for many identifications and the revision of the names of most of the shells enumerated in these notes. My thanks are also due to Mr. Sadasivan Chetty of Madras who kindly took the photographs illustrating this article.

A CONTRIBUTION TO THE FLORA OF THE PUNJAB AND THE ASSOCIATED HILL REGIONS

BY

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PART II.

(*Continued from Vol. xlii, No. 1, 149*).

XL. ANACARDIACEAE.

106. RHUS *L.*

190. **Rhus semialata** Murray.

Locality.—Rawalpindi (Jerram 8090! alt. 4,500 ft.).
Distribution.—Temperate Himalaya; from Bahahal to Sikkim, alt. 3-6,000 ft.; Khasia Hills, alt. 3-5,000 ft.

191. **Rhus rhodanthema** Engl.

Locality.—Lahore (Mustoe 11706!).
Flowers.—March; Bright crimson.

192. **Rhus copallina** L. Sp. Pl. 266.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 6771!).
Flowers.—December.
* Introduced from Cuba.
Distribution.—N. America.

193. **Rhus laevigata** L. Sp. Pl. ed. II, 1672.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38633!).
Flowers.—April.
Distribution.—S. Africa.

107. PISTACIA *L.*

194. **Pistacia integerrima** Stewart in Brandis For. Flor. 122, t. XXII.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 31045!).
Flowers.—March.
Distribution.—Cultivated. North-Western Frontier; Peshawar valley and Salt Range; Western Himalaya; alt. 1,200-8,000 ft., from the Indus to Kumaon, usually on hot slopes.

108. SCHINUS *L.*

195. **Schinus terebinthifolius** Raddi, in Mem. Mod. XVIII. Fis. (1820) 399.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14364!).
Flowers.—October.
Distribution.—Brazil.

196. **Schinus molle** L. Sp. Pl. 388.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38638 !, 11458).
Flowers.—February-May.
Distribution.—Tropical America.

197. **Schinus dependens** Orteg. Hort. Matr. Dec. 102.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14875 !).
Flowers.—April.
Distribution.—Brazil.

109. Odina *ROXB.*

198. **Odina Woodier** Roxb. Fl. Ind. II, 293.

Locality.—Gurdaspur (Fane 4859 !) ; Hoshiarpur (Ait. 514 !).
Flowers.—June.
Distribution.—India ; Ceylon.

XLI. LEGUMINOSAE.

1. *PAPILIONACEAE.*

110. Argyrolobium *ECKL. & ZEYL.*

199. **Argyrolobium flaccidum** Jaub. & Spach.

Locality.—Dalhousie (49 !).
Distribution.—India.

111. Crotalaria *L.*

200. **Crotalaria Burhia** Hamilt. in Wall. Cat. 5386.

Locality.—Lahore—Kot Lakhpat (Parker 14348 !) ; Rawalpindi (Ait. 691 !).
Flowers.—October.
Distribution.—Afghanistan, Baluchistan, N.-W. India, Gujarat, Rajputana, Sind.

201. **Crotalaria prostrata** Roxb. Hort. Beng. 54.

Locality.—Hoshiarpur (Ait. 567 !).
Distribution.—India. Ceylon, Java.

202. **Crotalaria alata** Hamilt. ex. Roxb. in Don. Prodr. 241.

Locality. Kangra (Jameson 33667 !, 33668 !) ; Hoshiarpur (Ait. 532 !).
Distribution.—Java ; N.-W. India.

203. **Crotalaria sericea** Retz.

Locality.—Gurdaspur (Drum. 2 !) ; Rawalpindi (Ait. 576 !).
Flowers.—October-November.
Distribution.—N.-W. India.

204. **Crotalaria medicaginea** Lamk. Dict. II, 201.

Variety.—neglecta.
Locality.—Hoshiarpur (Ait. 279 !).
Flowers.—August.
Distribution.—Malay isles ; Afghanistan ; China ; Australia. India—Rajputana, Sind, N.-W. India to Ceylon and Burma.

112. Trigonella *L.*

205. **Trigonella Foenum-graecum** L.

Locality.—Lahore (Stewart 2550 ! ; 2902 !) ; Rawalpindi (363 !).
Flowers.—April.
Distribution.—S. Europe and Orient, widely cultivated. N.-W. India.

113. MELILOTUS *JUSS.*

206. **Melilotus parviflora** Desf.

Locality.—Rawalpindi—Hussand (Ait. 370 !, 369 !, 368 !) ; Lahore (2933 ! ; Stewart 2557 !, 2602 !).
Flowers.—March-May.
Distribution.—Orient, Europe and introduced in many other regions. India.

207. **Melilotus alba** Lamk. Dict. IV, 63.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21718 !).
Flowers.—March ; White.
* Grown for fodder.
Distribution.—Europe ; Orient ; Siberia. India.

208. **Melilotus indica** All. Fl. Pedem I (1785) 308.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21716 !).
Flowers.—March ; Yellow.
* Grown for fodder.
Distribution.—Europe ; S. Persia ; Afghanistan ; Baluchistan and introduced in many other localities.

209. **Melilotus corylifolia** Linn.

Locality.—Rawalpindi (Ait. 371 !).
Flowers.—April ; Weed.

114. MEDICAGO *L.*

210. **Medicago falcata** L.

Locality.—Rawalpindi (*Ait. 364 !).
Flowers.—April.
* Cultivated for fodder (lucern).
Distribution.—Afghanistan ; Orient ; and all through Europe. N.-W. India.

211. **Medicago laciniata** All.

Locality.—Rawalpindi (Ait. 367 !, 1037 !).
Flowers.—March-April.
Distribution.—Abyssinia ; Egypt ; Baluchistan. India.

212. **Medicago denticulata** Willd.

Locality.—Lahore (* Parker 21715 !, Stewart 2552 !), Rawalpindi (Ait. 366 !).
Flowers.—March.
* Cold weather weed in grassy places.
Distribution.—Europe ; Abyssinia ; Baluchistan ; Orient ; China ; Japan ; Siberia. India.

213. **Medicago Minima** Lamk.

Locality.—Rawalpindi—Barrakow (Ait. 365 !).
Flowers.—April.
Distribution.—Afghanistan ; Orient ; Mediterranean region ; Abyssinia ; Europe. India.

115. CYAMOPSIS *DC.*

214. **Cyamopsis psoralioides** DC.

Locality.—Rawalpindi—Futtehgunj (Ait. 372 !).
Flowers.—August.
Distribution.—Afghanistan. India—Rajputana, Sind.
Quite wild and not cultivated N.-W. of the Jhelum river.

116. INDIGOFERA *L.*

215. **Indigofera echinata** Willd.

Locality.—Rawalpindi—Googerkhaw (Ait. 374 !).
Flowers.—June.
Distribution.—Guinea. India—Western Peininsula. Ceylon.

216. **Indigofera cordifolia** Heyne.

Locality.—Rawalpindi (Ait. 140 !).
Flowers.—August.
Distribution.—Afghanistan ; Baluchistan ; Nubia ; Malay Isles ; N. Australia. India.

217. **Indigofera hirsuta** L.

Locality.—Hoshiarpur (Ait. 533 !).
Distribution.—Tropical America ; Java ; Philippines ; N. Australia. India.

218. **Indigofera tinctoria** L.

Locality.—Hoshiarpur (Ait. 295 !).
Distribution.—Tropical regions, cultivated for local use.

219. **Indigofera hebepetala** Benth. Mss.

Locality.—Rawalpindi (Jerram 8274 !).
Flowers.—July.
Distribution.—India—Himalayas, from Kashmir to Sikkim, alt. 6-15,000 ft.

220. **Indigofera pulchella** Roxb. Hort. Beng. 57.

Locality.—Hoshiarpur (Ait. 530 !).
Distribution.—Throughout the Himalayas and hills of India proper, ascending to 5,000 ft., in Kumaon.

117. PSORALEA *L.*

221. **Psoralea plicata** Delile.

Locality.—Lahore—Chang (* Parker 13790 !) ; Lahore 2903 ! ; Hissar (Duthie 5234 !).
Flowers.—August-September. Petals pale yellow, tipped with purple.
Distribution.—Arabia ; Egypt ; Tropical Africa. India—Plains of the Punjab.

118. EYSENHARDTIA *H. B. & K.*

222. **Eysenhardtia amorphoides** H. B. & K. Nov. Gen. et. Sp. VI, 489.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 38771 !, 21023 !).
Flowers.—March-August.
* Seed from Mexico. Petals all free. St. 9, 1, Anthers uniform. Ovary 2-ovulate. A shrub 6 ft. high. Leaves absolutely gland-dotted.
Distribution.—Mexico.

119. AMORPHA *L.*

223. **Amorpha fruticosa** L. Sp. Pl. 713.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38840 !, 13639 !, 13638 !, 13637 !, 12946 !).
Flowers.—June-August.
Distribution.—N. America.

120. MILLETTIA *WT. & ARN.*

224. **Millettia ovalifolia** Kurz in Journ. Asiat. Soc. Beng. XLII, 2, 68, excl. Syn. W. & A.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11460!, 14372!, 12969!, 38862!); Ravi Park (Parker 38640!).
Flowers.—April-August.
Distribution.—Burma.

121. TEPHROSIA *PERS.*

225. **Tephrosia tenuis** Wall. Cat. 5970.

Locality.—Rawalpindi (Ait. 145!); Barrokow (Ait. 375!).
Flowers.—August-September.
Distribution.—Laccadives. India—plains of Sind, Rajputana, the Punjab, Konkan.

226. **Tephrosia purpurea** Pers. Syn. Pl. II (1807) 329.

Locality.—Rawalpindi (Ait. 579!).
Flowers.—October.
Distribution.—India—Rajputana. Ceylon. Everywhere in the tropics.

227. **Tephrosia Hamiltonii** J. R. Drum. in Gamble. Fl. Madras (1918) 320.

Locality.—Pabbi Hills (Parker 24514!, 24516!).
Flowers.—December.
Distribution.—India.

122. SESBANIA *PERS.*

228. **Sesbania aegyptiaca** Pers.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 6776!, 6775!).
Flowers.—December.
A small tree—20 ft. high.
Distribution.—Cosmopolitan in tropics of Old World.

229. **Sesbania aculeata** Pers.

Locality.—Multan (Holland 26316!; 36130); Lahore—Kot Lakhpat (Parker 14327!, 14328., 14329!); Rawalpindi (Ait. 186!, 575!).
Flowers.—July-October.
Grows up to 8.9 ft. high.
Distribution.—Tropics of the Old World. India—Rajputana, Sind.

123. ASTRAGALUS *L.*

230. **Astragalus prolixus** Sieber Pl. Aegypt. Exsic.

Locality.—Lahore 2910!; (Stewart 2528!).
Flowers.—March.
Distribution.—Cape Verde Islands; Egypt; Arabia. India—Plains of Sind and Punjab.

231. **Astragalus Aitchisoni** Baker.

Locality.—Rawalpindi (Ait. 1040!).
Flowers.—February.
Distribution.—India—Punjab.

232. **Astragalus tribuloides** Delile.

Locality.—Lahore (Stewart 2527!); Rawalpindi (Ait. 379!); Lyallpur (Inayat).
Flowers.—March-May.
Distribution.—Canaries through Egypt to Afghanistan. India—Plains of the Punjab.

233. **Astragalus pyrrhotrichus** Boiss. Diag. IX, 73.

Locality.—Near Peshawar (Collett 57 !); Rawalpindi—between Huzroo and Attsel on plains (* Ait. 1043 !).

* Not common.

Distribution.—Afghanistan. India—the Punjab.

234. **Astragalus Psilocentros** Fisch. in Bull. Soc. Nat. Mosc. (1853) II, 405 = *polyacanthus.*

Locality.—Pabbi, west of Jhelum (Lambert 39880, alt. 1,100 ft.); Rawalpindi (Ait. 378 !).

Flowers.—March.

Distribution.—India—Himalayan region.

235. **Astragalus composum** Bth. ex Bunge, Astrag. II, 3.

Locality.—Rawalpindi (Ait. 376 !); Near Peshawar (Collett 57 !).

Flowers.—April.

Distribution.—Afghanistan.

124. Taverniera *DC.*

236. **Taverniera nummularia** DC. Prodr. II, 339.

Locality.—Rawalpindi (23990 !, 6153 !); (Ait. 146 !, 380 !).

Flowers.—April-August-December.

Distribution.—Orient; Afghanistan; Baluchistan. India—Plains of Sind and the Punjab.

125. Onobrychis *GAERTN.*

237. **Onobrychis Stewartii** Baker.

Locality.—Rawalpindi (Ait. 377 !).

Flowers.—April.

Distribution.—India—the Punjab.

126. Lespedeza *MICH.*

238. **Lespedeza sericea** Miq. Ann. Mus. Lug. Bat. III, 49.

Locality.—Dalhousie (244 !, 245 !, 246 !, 247 !; Drum's collection); Rawalpindi—Barrakow and Triete (Ait. 383 !).

Flowers.—September.

Distribution.—China; Japan; N. Australia. India—the Punjab.

239. **Lespedeza eriocarpa** DC.

Locality.—Dalhousie (34 !; Drum's Herb.); Rawalpindi—Murree (Ait. 1048 ! alt. 7,000 ft.).

Flowers.—July.

Distribution.—India—the Punjab.

127. Alhagi *DESV.*

240. **Alhagi camelorum** Fisch. Ind. Hort. Gorenk. ed. 2 (1812) 72.

Locality.—Lahore—Ag. Hort. Gdns. (Parker * 13640 !, 13135 !, 13809 !, 13808 !); Chang (Parker 13783 !).

Flowers.—April-September.

* Wild.

Distribution.—Egypt; Arabia. India—Sind, Rajputana, N. and N.-W. Provinces. Baluchistan.

128. Zornia GMEL.

241. **Zornia diphylla** Pers.

Locality.—Dalhousie (Drum. 33 !).
Flowers.—August.
Distribution.—Everywhere in the Tropics. India—Plains from the Himalayas to Ceylon and Burma.

129. Uraria DESV.

242. **Uraria neglecta** Prain in Journ. As. Soc. Beng. LXVI, 382, 1897.

Locality.—Hoshiarpur (Ait. 463 !).
Distribution.—India.

130. Alysicarpus NECK.

243. **Alysicarpus longifolius** W. & A. Prodr. 233.

Locality.—Lahore (2950).
Distribution.—Plains, scattered throughout India proper.

131. Ougeinia BENTH.

244. **Ougeinia dalbergioides** Benth. Pl. Jungh. 216.

Locality.—Hoshiarpur (Holland 45329 !); (Mardainali 337 !).
Flowers.—March.
Distribution.—Hilly tracts of Northern India and Konkan, ascending to 4,000 ft. in Kumaon.

132. Desmodium DESV.

245. **Desmodium laxiflorum** DC. Prodr. II, 335.

Locality.—Dalhousie (Drum. 4616 !).
Distribution.—Java; Borneo; Philippines. India.

246. **Desmodium podocarpum** DC. Prodr. II, 336.

Locality.—Dalhousie (Drum. 59 !).
Flowers.—September.
Distribution.—China; Japan. India—temperate and tropical Himalayas. alt. 2,000-7,000 ft., from Simla and Gharwal to Khasia and Sikkim.

247. **Desmodium tiliaefolium** G. Don Gen. Syst. II, 297.

Locality.—Rawalpindi—Triete (Ait. 382 !).
Flowers.—September.
Distribution.—All along the Himalayas from the upper Punjab to Tavoy. Temperate and tropical zones, ascending to 9,000 ft.

248. **Desmodium gangeticum** DC. Prodr. II, 327.

Locality.—Hoshiarpur (Ait. 471 !).
Distribution.—Tropical Africa; Malay Isles; Philippines; China, introduced in West Indies. India.

133. Abrus L.

249. **Abrus precatorius** L.

Locality.—Hoshiarpur (Ait. 519 !).
Distribution.—India—Himalayas to Ceylon and Siam. Cosmopolitan in the Tropics, often planted.

134. Cicer L.

250. **Cicer arietinum** L.

Locality.—Lahore (Stewart 2554 !).
Flowers.—March.
Distribution.—India—Commonly cultivated in northern provinces and Nilgiris. Cultivated in various temperate and tropical countries.

135. Vicia *L.*

251. **Vicia hirsuta** Koch. Synops. 191.

Locality.—Peshawar College (Quizilbash 23 !) ; Hoshiarpur (Ait. 575 !).
Distribution.—Europe ; Orient. India—N.-W. Provinces.

252. **Vicia pallida** Turcz.

Locality.—Rawalpindi—Hussanal (Ait. 389 !).
Flowers.—March.
Distribution.—Siberia. India.

253 **Vicia Griffithii** Baker.

Locality.—Rawalpindi—Futtehgunj (Ait. 10461 !) ; Hussanal (Ait. 389 !, 1045 !).
Flowers.—March.
Distribution.—Afghanistan. India.

254. **Vicia sativa** L.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 21705 !, 21706 !) ; near Peshawar (Collett) ; Lahore (Stewart 2529 !) ; Rawalpindi (Ait. 385 !, 387 !, 386 !).
Flowers.—March-April.
* Weed in wheat crop.
Distribution.—India—N.-W. Provinces, probably cultivated.

255. **Vicia bithynica** L. Syst. ed. x, 1166.

Locality.—Gurdaspur (Drum. 11 !).
Flowers.—February.
Distribution.—Mediterranean region.

136. Lathyrus L.

256. **Lathyrus Aphaca** L. ; DC. Prodr. II, 372.

Locality.—Rawalpindi (Ait. 391 !) ; Lahore (Stewart 2915 !).
Flowers.—March-April.
Distribution.—Europe ; Orient ; Abyssinia. India—spread through the N. Provinces, ascending from the plains of Bengal to the temperate zone in Hazara, Kashmir and Kumaon.

257. **Lathyrus sativus** L. ; DC. Prodr. II, 373.

Locality.—Rawalpindi—Hoshiarpur (Ait. 91 !) ; Barrakow (Ait. 393 !).
Flowers.—April.
Distribution.—Europe ; Orient ; Tropical Africa. India—spread through the N. Provinces, ascending from the plains of Bengal to Kumaon.

258. **Lathyrus sphaericus** Retz. ; D.C. Prodr. II, 372.

Locality.—Gurdaspur (Drum. 9 !) ; Hoshiarpur (Ait. 1047 !).
Flowers.—February ; Colour—vermilion.
Distribution.—Europe ; Orient ; Abyssinia. India—N.-W. Provinces, ascending from Bundelkhand and the Punjab to 5,500 ft. in Kumaon.

259. **Lathyrus inconspicuus** L. ; DC. Prodr. II, 372.

Locality.—Rawalpindi (Ait. 394 !).
Flowers.—April.
Distribution.—Mesopotamia ; Syria ; Afghanistan ; Baluchistan. India—Sind, the Punjab.

137. MUCUNA *ADANS.*

260. **Mucuna pruriens** DC. Prodr. II, 405.

Locality.—Hoshiarpur (Ait. 470 !).
Distribution.—Cosmopolitan in the Tropics. India—from the Himalayas, in the plains to Ceylon and Burma.

138. ERYTHRINA *L.*

261. **Erythrina Crista-galli** L. Mant 1, 99.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 13735 !, 13131 !).
Flowers.—May. Bright pink.
* Almost spine-less form. A small tree 20 ft. high. Bark rough corky. In winter shoots die back for 18 in. apparently naturally and not owing to frost.
Distribution.—Brazil.

262. **Erythrina Blakei** Hort.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 13666 !).
Flowers.—May.
* Grown in N. Indian gardens as *E. Blakei.* Seems to be a hybrid or form of *E. herbacea* L.

139. BUTEA *ROXB.*

263. **Butea frondosa** Roxb. Cor. Pl. 21, t. 21.

Locality.—Hoshiarpur (Ait. 124 !).
Distribution.—Plains from the Himalayas to Ceylon and Burma, ascending to 4,000 ft. in the North-west, Rajputana, Sind.

140. PHASEOLUS *L.*

264. **Phaseolus aconitifolius** Jacq. Obs. III, t. 52.

Locality.—Rawalpindi—Huzzoo (Ait. 570 !).
Flowers.—October.
Distribution.—Himalayas to Ceylon, tropical region, upto 4,000 ft. in the north-west; native of India, generally cultivated.

141. ATYLOSIA *W. & A.*

265. **Atylosia scarabaeoides** Benth. Pl. Jungh. 243.

Locality.—Hoshiarpur (Ait. 631 !).
Distribution.—China; Malaya; Mauritius; Madagascar. Universally spread in the plains throughout India.

266. **Atylosia crassa** Prain in Journ. As. Soc. Beng. 268, LXVI, 45432.

Locality.—Rawalpindi—Rajgarh (Parker 6504 !).
Flowers.—December.
Distribution.—Java; Philippines. India—N.-W. Provinces, Bengal, S. India, Assam, Burma.

142. CAJANUS *DC.*

267. **Cajanus indicus** Spreng. Syst. III, 248.

Locality.—Hoshiarpur (* Ait. 582 !).
* Seems indigenous in the low hills at Hoshiarpur with small leaves.
Distribution.—Everywhere in the tropics; probably native of the Old World.

143. Rhynchosia *LOUR.*

268. **Rhynchosia minima** DC. Prodr. II, 385.

Locality.—Jullandar—* Phillaur Plantation (7712 !); Hissar (Duthie 3953 !, 2908 !); Lahore (Stewart 2618 !); Lyallpur (Inayat !); Multan !; Rawalpindi (Ait. 214 !, 135 !); Hoshiarpur (Ait. 81 !).
Flowers.—August-February.
* Abundant in the P. Plantations. Stems sometimes woody at the base.
Distribution.—Cosmopolitan in the Tropics; Cape; United States; Ceylon. India—Rajputana, Sind and everywhere in the plains.

269. **Rhynchosia sericea** Spanoghe in Linnaea, xv, 105.

Locality.—Hoshiarpur (Ait. 465 !).
Distribution.—Malaya. India.

144. Flemingia *ROXB.*

270. **Flemingia fruticulosa** Wall. Cat. n. 5754 = *strobilifera.*

Locality.—Dalhousie—(4742 !; Drum.'s Herb.).
Distribution.—Malaya. India.

271. **Flemingia congesta** Roxb. Hort. Beng. 56.

Variety.—semialata.
Locality.—Rawalpindi (Parker 7711 !).
Flowers.—June.
Distribution.—Malay Isles; China; Philippines; India. Ceylon.

145. Dalbergia *L. f.*

272. **Dalbergia Sissoo** Roxb. Hort. Beng. 53.

Locality.—Rawalpindi (Ait. 395 !).
Flowers.—April.
Distribution.—Afghanistan; Baluchistan. Plains throughout India ascending to 5,000 ft. in the Central Himalaya.

146. Pongamia *VENT.*

273. **Pongamia glabra** Vent. Jard. Malm. t. 28.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14363 !, 13806 !, 14362 !, *13732 !, * 13731 !, 13662 !, 38644 !, 13119 !); Hoshiarpur (Holland 11138 !); (Ait. 478 !).
Flowers.—April-May. *Fruits.*—January.
* Leaflets of different shape from ordinary form. Flowers much earlier at Lahore and is not easy to grow from seed. Suffers from cold and damp in winter, whereas ordinary Pongamia very hardy. Flowers more highly coloured, and petals and ovary more hairy (from Parker's notes).
Distribution.—Malaya Isles; N. Australia; Polynesia; Seychelles. India—Central and East Himalayas to Ceylon and Malacca.

147. Derris *LOUR.*

274. **Derris robusta** Benth. in Journ. Linn. Soc. IV, Suppl. 104.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38782 !, 38783 !, 13734 !, 13733 !).
Flowers.—April-August.
Distribution.—India— Eastern Himalayas, Western Peninsula. Ceylon.

148. Sophora *L.*

275. **Sophora mollis** Grah. in Wall. Cat. 5335.

Locality.—Rawalpindi (Ait. 396 !).
Flowers.—May.
Distribution.—India—Plains and low hills of the north-west; Hazara and Salt Range to Kumaon and Nepal, ascending to 4,000 ft.

276. **Sophora secundiflora** Lag. ex DC. Cat. Hort. Monsp. (1813) 148.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 18074!, 18073!, 13126!).
Fruits.—April-July.
Distribution.—Mexico.

149. CASTANOSPERMUM *A. CUNN.*

277. **Castanospermum australe** A. Cunn. & Fraser, in Hook. f. I, 556.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13810!).
Flowers.—May.
Distribution.—Australia.

2. *CAESALPINEAE.*

150. CAESALPINIA *L.*

278. **Caesalpinia pulcherrima** Swartz Obs. 166.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13614!).
Flowers.—January
Distribution.—Universally cultivated throughout India and elsewhere in the Tropics; the native country is not clearly known.

279. **Caesalpinia sepiaria** Roxb. Hort. Beng. 32.

Locality.—Hoshiarpur (Ait. 601!).
Distribution.—Malay Isles; China; Japan; and introduced in Tropical America. India.

280. **Caesalpinia Gilliesii** Wall. ex Hook. Bot. Misc. i (1830) 129.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13611!, 13113!).
Flowers.—April-July.
Distribution.—South America.

281. **Caesalpinia coriaria** Willd. Sp. Pl. ii.; 532.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 14861!).
Flowers.—November.
* Suffers from frost.
Distribution.—South America.

151. GLEDITSCHIA *CLAYTON.*

282. **Gleditschia triacanthos** L. Sp. Pl. 1056.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 143671!, 14366!, 12977!).
Flowers.—April.
Distribution.—North America.

152. PARKINSONIA *L.*

283. **Parkinsonia aculeata** L. Sp. Pl. (1753) 375.

Locality.—Kangra (Bisram 53113!); Lahore—Forest Office (Parker 12992!).
Flowes.—April. *Fruits.*—May.
Distribution.—Universally cultivated and often naturalized. A native of Tropical America.

153. CASSIA *L.*

284. **Cassia Fistula** L. Sp. Pl. (1753) 377.

Locality.—Rawalpindi (Ait. 397!); Gurdaspur (Bisram 846!).
Flowers.—July.
Distribution.—China; Malay Isles; Ceylon. India.

285. **Cassia Sophera** L. Sp. Pl. (1753) 379.

Locality.—Lahore—Changa Manga (Parker 24335 !, 24336 !, 24337 !); Ag. Hort. Gdns. (Parker 13736 !); Gurdaspur (Drum. 61 !).
Flowers.—May-December.

286. **Cassia Sophera** L. var. *purpurea* Roxb. Hort. Beng. 31.

Locality.—Lahore—Changa Manga (Parker 25743 !, 24334 !, 24333 !).
Flowers.—December.
Distribution.—As in *C. Sophera L.*

287. **Cassia Tora** L. Sp. Pl. (1753) 376.

Locality.—Hoshiarpur (* Parker 14378 !); Ait. 513 !); Rawalpindi (Ait. 1891 !).
Flowers.—August-September.
* Abundant on grazing grounds and not eaten by cattle.
Distribution.—India. Ceylon; and the Tropics generally.

288. **Cassia bicapsularis** L. Sp. Pl. (1753) 376.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 37195 !, 37194 !).
Fruits.—January.
Distribution.—Tropical America.

289. **Cassia laevigata** Willd. Enum. Hort. Beng. 441.

Locality.—Lahore—Changa Manga (* Parker 19330 !, 19329 !).
Flowers.—May.
* Cultivated.
Distribution.—Cosmopolitan in the Tropics.

290. **Cassia didymobotrya** Fresen. in Flora, XXII (1839) 53.

Locality.—Lahore—Changa Manga (Parker 1933 !).
Distribution.—Abyssinia. Cultivated.

291. **Cassia corymbosa** Lam. Encyc. i, 644.

Locality.—Lahore—Changa Manga (Parker 24234 !).
Fruits.—December.
Distribution.—America. Cultivated.

292. **Cassia mimosoides** L. Sp. Pl. 379.

Locality.—Rawalpindi—Barrakow (Ait. 398 !).
Fruits.—August.
Distribution.—Cosmopolitan in the Tropics; probably native in Asia only.
Distribution.—Southern Europe, Orient.

154. Ceratonia *L.*

293. **Ceratonia siliqua** L. Sp. Pl. 1026.

Locality.—Ferozepore—Fazilka (Parker 14374 !, 14373 !, 14375 !).
Flowers.—October.
Distribution.—Cosmopolitan in the Tropics, Ceylon, India.

155. Bauhinia *L.*

294. **Bauhinia racemosa** Lam. Dict. I, 390.

Locality.—Hoshiarpur (Ait. 473 !).
Distribution.—Ceylon, China, Malay Isles, Timor. Throughout India.

295. **Bauhinia Vahlii** W. & A. Prodr., 297.

Locality.—Hoshiarpur (Ait. 517 !).
Distribution.—Throughout India in hilly districts.

296. **Bauhinia candicans** Benth. in Mart. Fl. Bras. XV. ii, 201.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38773 !).
Flowers.—August.
Distribution.—Brazil.

297. **Bauhinia corymbosa** Roxb. Hort. Beng. 31. Fl. Ind. ii, 329.

Flowers.—May.
Distribution.—China.

156. SCHOTIA *JACQ.*

298. **Schotia brachypetala** Sond. in Linnaea, XXIII (1850) 39.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13139 !).
Flowers.—April.
Distribution.—South Africa.

157. PIPTADENIA *BENTH.*

299. **Piptadenia nitida** Benth. in Journ. Bot. iv (1842) 336.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 39654 !, 39655 !, 39656 !).
Flowers.—April.
Distribution.—Brazil.

3. *MIMOSEAE.*

158. PROSOPIS *L.*

300. **Prosopis spicigera** L. Mantiss (1767) 68.

Locality.—Hissar (Duthie 3962 !).
Flowers.—October.
Distribution.—Afghanistan; Persia. India—Punjab, Rajputana, Sind. Bundelkhand and dry regions of W. Peninsula, Baluchistan.

301. **Prosopis juliflora** DC. Prodr. II, 447.

Variety.—*glandulosa* Sarg.
Locality.—Lahore—Forest Office (* Parker 13624 !, 13133 !, 12973 !, 12945 !): Changa Manga (7904 !).
Flowers.—April-May; *Fruits.*—May-June.
* Original seed from Mexico.
Distribution.—Tropical America.

302. **Prosopis juliflora** DC. Prod. II, 447.

Variety.—*velutina* Sarg.
Locality.—Lahore—Forest Office (* Parker 17188 !, 17187 !, 17186 !, 23988 !).
Flowers.—June-July.
* Evergreen, seed from Mexico.

303. **Prosopis alba** Gieseb. in Goett. Abh XIX (1874) 131.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 408 !).
Original seed from Buenos Ayres.
Distribution.—Argentine.

159. DICHROSTACHYS *DC.*

304. **Dichrostachys nutans** Benth. in Hook. Journ. Bot. IV (1842) 353.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38637 !, 37128 !, 37127 !).
Flowers.—January-May.
Distribution.—Tropical Africa.

160. DESMANTHUS *WILLD.*

305. **Desmanthus virgatus** Willd. Sp. Pl. iv, 1047.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 7776 !, 7777 !, 4460 !).
Flowers.—November.
* A naturalized weed.
Distribution.—North America. Western India.

161. MIMOSA *L.*

306. **Mimosa rubicaulis** Lam. Encyc. Menth. V. i. (1783) 20.

Locality.—Rawalpindi (Jerram 7897 ! alt. 3,000-5,000 ft., 7718 !); (Ait. 147 !); Hoshiarpur (Ait. 282 !).
Flowers.—May-June.
Distribution.—Afghanistan. Throughout India.

307. **Mimosa acerba** Benth. in Hook.—Journ. Bot. iv (1842) 378.

Locality.—Lahore—Changa Manga (Parker 21894 !).
Flowers.—August.
Cultivated : Original seed from Argentina.
Distribution.—Brazil.

308. **Mimosa hamata** Willd. Sp. Pl. v 4. (1805) 1033.

Locality.—Hissar (Duthie 396 !); Lahore—Changa Manga (Parker 20119 !).
Flowers.—October.
Cultivated.
Distribution.—India—W. Peninsula.

309. **Mimosa himalayana** Gamble. in Kew Bull. 1920, 4.

Locality.—Lahore—Changa Manga (Parker 24425 !, 24424 !, 24426 !).
Flowers.—December.
Distribution.—India.

162. LEUCAENA BENTH.

310. **Leucaena glauca** Benth. in Hook. Journ. Bot. iv. 416.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14376 !).
Flowers.—September.
Distribution.—Spread throughout India, as it is through Tropical Asia and Africa, but probably indigenous in Tropical America.

163. ACACIA *WILLD.*

311. **Acacia Farnesiana** Willd. Sp. Pl. V. 4 (1805) 1083.

Locality.—Rawalpindi (Ait. 570 !).
Flowers—December.
Distribution.—Cosmopolitan in the Tropics, often planted.

312. **Acacia arabica** Willd. Sp. Pl. V. 4 (1805) 1085.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38848 !); Changa Manga—(Parker 18077 !, 18078 !, 18079 !, 18080 !, 18032 !, 18034 !, 18035 !, 18036 !, 18037 !, 18033 !, 18038 !); Multan (Monro 35 !); Rawalpindi (Ait. 148 !).
Flowers.—April-September.
Grown from seed supplied by Vilmorin Paris as *A. Nilotica.* In Lahore it flowers at the same time as the local variety and has the same pods (Parker).
Distribution.—Ceylon, Arabia, Egypt, Tropical Africa, Natal, Throughout the greater part of India.

313. **Acacia eburnea** Willd. Sp. Pl. V. 4 (1805) 1081.

Locality.—Rawalpindi (Ait. 48!, 399!; Parker 24015!).
Flowers.—April-September.
Distribution.—Arabia, Afghanistan. Throughout India in dry districts, Ceylon.

314 **Acacia leucophloea** Willd. Sp. Pl. V. 4 (1805) 1083.

Locality.—Lahore—Changa Manga (Parker 14326!, 14325!); Hoshiarpur (Ait. 523!).
Flowers.—September.
Distribution.—Malay Isles, Timor. Throughout India in dry districts.

315. **Acacia Catechu** Willd. Sp. Pl. V. 4 (1805) 1079.

Locality.—Hoshiarpur (Ait. 524!); Rawalpindi (Ait. 188!).
Flowers.—September.
Distribution.—India (Punjab, N.-W. Himalayas, Central India, Berar, Gurgaon, Burma); often planted.

316. **Acacia modesta** Wall. Pl. As. Rar. t. 130.

Locality.—Rawalpindi (7716!; Ait. 400!).
Flowers.—April-December.
Distribution.—Afghanistan. India (Western and Central Himalayas).

317. **Acacia torta** Craib in Kew. Bull. 1915, 410 = Mimosa torta.

Locality.—Hoshiarpur (Ait. 516!).
Distribution.—Asia and Tropical Africa.

318. **Acacia aneura** F. Muell in Linnaea XXVI (1853-55) 627.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38631!).
Flowers.—May.
Distribution.—Australia.

319. **Acacia auriculaeformis** A. Cunn. ex. Benth, in Hook Lond. Journ. Bot., i (1842) 377.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 37258!, 17192!).
Flowers.—October; *Fruits.*—January.
Distribution.—Australia.

320. **Acacia bonariensis** Gill. in Hook. Bot. Misc. iii (1833) 207.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38632!, 37257!, 33099!).
Flowers.—May-August.
Seed from Formosa.
Distribution.—Argentine.

321. **Acacia confusa** Merrill in Philipp. Journ. Sec. v, 27 (1910).

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38632!, 37257!, 21044!).
Flowers.—April-May; *Fruits.*—January.
Distribution.—Philippine Islands.

322. **Acacia constricta** Benth. in A. Gray. Pl. Wright i. 66.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14884!).
Flowers.—April; Sweet scented.
A struggling shrub. Introduced from Mexico.
Distribution.—North Mexico.

323. **Acacia filicina** Willd. Sp. Pl. iv. 1072.

Locality.—Lahore—Changa Manga (* Parker 24231!); Ag. Hort. Gdns. (Parker 13647!, 13646!, 13645!, 13644!, 12943!, 11444!).
Flowers.—April-June. *Fruits.*—December-February.
* Cultivated. A shrub 6 ft. high; seed from Mexico.
Distribution.—Mexico.

324. **Acacia homalophylla** A. Cunn. ex Benth. in Hook. Journ. Bot. i (1842) 365.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14885 !, 11548).
Flowers.—January.
Distribution.—Australia.

325. **Acacia sphaerocephala** Cham. Schlecht in Linnaea V (1830) 594.

Locality.—Lahore—Government House Gdns. (* Parker 15039 !).
Flowers.—May.
* Spines 2½ in. long and ½ in. broad. Extraordinarily large.
Distribution.—Mexico.

326. **Acacia spadicigera** Cham. & Schlecht in Linnaea V (1830) 594.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15041 !).
Flowers.—May.
Distribution.—Jamaica.

164. Calliandra *BENTH.*

327. **Calliandra grandiflora** Benth. in Hook Journ. Bot. II (1840) 139.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38887 !, 13670 !, 11457 !).
Flowers.—May-August ; *Fruits.*—February.
Distribution.—Tropical America.

165. Albizzia *DURAZZ.*

328. **Albizzia Lebbeck** Benth. in Hook. Lond. Journ. Bot. V. 3 (1844) 87.

Locality.—Rawalpindi (Ait. 240 !, 401 !).
Flowers.—May.
Distribution.—Tropical and subtropical Asia and Africa. Throughout India. Usually planted.

329. **Albizzia odoratissima** Benth. in Hook. Journ. Bot. V. 3 (1844) 88.

Locality.—Rawalpindi—Saligraon (Parker 7713 !) ; Gurdaspur-Dhunera (Bisram 302 !).
Fruits.—February.
Distribution.—Throughout India. Ceylon.

330. **Albizzia mollis** Boiv. in Encyc. XIX. Siecle, II, 33.

Locality.—Dalhousie 3,000-5,000 ft. (Drum. 22 !).
Flowers.—August.
Distribution.—Tropical Africa.

331. **Albizzia stipulata** Boiv. in Encyc. du xix Siecle, V 2, 33.

Locality.—Dalhousie.
Distribution.—S.-E. Asia. Throughout India.

166. Pithecolobium *MART.*

332. **Pithecolobium dulce** Benth. in Hook. Journ. 1844, 199.

Locality—Lahore—Ag. Hort. Gdns.—(Parker 13125 !) ; Forest Office (Parker* 14882 !, ** 17185 !).
Flowers.—April-May ; *Fruits.*—July.
* Grown from Mexican seed.
* * Seed from Esperanza, Sonora, Mexico. A frost-hardy form.
Distribution.—A native of Tropical Africa. Ceylon ; Malay Isles ; Philippines. Cultivated throughout India, but not indigenous.

XLII. ROSACEAE.

167. Prunus L.

333. **Prunus communis** Huds.

Locality.—Rawalpindi (Ait. !).
Flowers.—February.
Distribution.—India.—W. temperate Himalaya, cultivated, or indigenous from Gharwal to Kashmir, alt. 5-7,000 ft.

168. Spiraea L.

334. **Spiraea prunifolia** Sieb & Zucc. Fl. Jap. I, 131.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14879 !, 11455 !).
Flowers.—February. 2-3 ft. high.
Distribution.—Japan.

169. Rubus L.

335. **Rubus fruticosus** L. Sp. Pl. 493.

Locality.—Rawalpindi—(Jerram 8086 !, 8085 !).
Flowers.—June.
Distribution.—Europe.

170. Rosa L.

336. **Rosa multiflora** Thunb. Fl. Jap. 214.

Locality.—Lahore.—Ag. Hort. Gdns. (Parker 12955 !).
Flowers.—April.
Distribution.—Japan ; China.

171. Pyrus L.

337. **Pyrus communis** L. Sp. Pl. 479.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 12991 !).
Flowers.—April.
A French variety which ripens its fruits in the plains. Most do not.
Distribution.—N. Persia westwards to S. Europe. India—Cultivated in the N.-W. Himalayas, alt., 2-8,000 ft.

172. Crataegus L.

338. **Crataegus saligna** Greene, Pittonia III, 99.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14845 !, 14244 !).
Distribution.—North America.

173. Cotoneaster L.

339. **Cotoneaster microphylla** Wall. Cat. 662 A.

Locality.—Rawalpindi (Jerram 8064 !, 6,500 ft.)
Flowers.—June.
Distribution.—India—temperate Himalaya, alt. 4-8,000 ft.

XLIII. SAXIFRAGACEAE.

174. Deutzia THUNB.

340. **Deutzia staminea** R. Br. in Wall. Pl. As. Rar 82, t. 191.

Locality.—Rawalpindi—alt. 5,500 ft. (Jerrum 7902 !).
Flowers.—May.
Distribution.—India—temperate W. Himalayas to Kashmir, alt. 5-9,000 ft., common.

XLIV. HAMAMELIDACEAE.

175. Parrotia *C.A. MEY.*

341. **Parrotia Jacquemontiana** Dcne. in Jacq Voy. Bot. t. 82.

Locality.—Rawalpindi 8,000 ft. (Ait. 121 !).
Flowers.—May.
Distribution.—India—Kashmir, alt. 5-9,000 ft., common.

XLV. COMBRETACEAE.

176. Terminalia *L.*

342. **Terminalia belerica** Roxb. Cor. Pl. V, 2 (1798) 54, t, 198.

Locality.—Hoshiarpur (Ait. 488 !).
Distribution.—Ceylon, Malaya. Throughout India except Sind and desert region of the **west.**

343. **Terminalia Arjuna** Bedd. Fl. Sylv. t. 28.

Locality.—Hoshiarpur (Ait. 538 !).
Distribution.—India—sub-Himalayan tracts of the N.-W. Provinces, W. Peninsula; Ceylon.

177. Anogeissus *WALL.*

344. **Anogeissus latifolia** Wall. Cat. (1828) 4015.

Locality.—Kangra 9733 !
Flowers.—November.
Distribution.—Throughout the greater part of India; Ceylon.

178. Combretum *L.*

345. **Combretum coccineum** Lamk Encyc. I 734.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13674 !).
Flowers.—May.
Distribution.—Madagascar; Mauritius.

179. Callistemon *R.Br.*

346. **Callistemon coccineus** F. Muell Fragm. I, 13.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 137381 !).
Flowers.—April. Deep crimson.
Distribution.—Australia.

XLVI. MYRTACEAE.

180. Melaleuca *L.*

347. **Melaleuca Leucadendron** *L.*

Locality.—Lahore—Ravi Park (Parker 38643 !); Ag. Hort. Gdns. (Parker 13128 !).
Flowers.—April-May.
Distribution.—Malay Islands to Australia.

181. Eucalyptus *L' HERIT.*

348. **Eucalyptus bicolor** A. Cunn. ex Hook. in Mitch. Journ. Austral. 390.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11445 !, 11547 ! 38680 !, 38679 !, * 38678 !); Lawrence Gdns. (Parker 22420 !).
Flowers.—May.
* From French seed sown in April.
Distribution.—Australia.

349. **Eucalyptus affinis** Deane & Maiden in Proc. Linn. Soc. N. S. Wales XXIV 454.

Locality.—Lahore (Parker 22462 !).
Seedling grown in Lahore from Australian seed.
Distribution.—Australia.

350. **Eucalyptus Bosistoana** F. Muell.

Locality.—Lahore (* Parker 22459 !).
* Seedling grown in Lahore from Australian seed.
Distribution.—Australia.

351. **Eucalyptus cornuta** Labill .Voy. I, 403 t. 20.

Locality.—Lahore—Lawrence Gdns. (Parker 22481 !).
Distribution.—Australia.

352. **Eucalyptus foecunda** Schau. Lehm. Pl. Preiss I, 130.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38672 !, 38671 !, 38670 !, 14866 !).
Flowers.—May.
* Seed from W. Australian Forest Dept., sown April 1912, planted August 1912. Flowering as a shrub 3 ft. high in February 1916.
Distribution.—Australia.

353. **Eucalyptus gomphocephala** DC. Prod. III, 220.

Locality.—Lahore—Lawrence Gdns. (Parker 22482 !).
Distribution.—Australia.

354. **Eucalyptus crebra** F. Muell. in Journ. Linn. Soc. III (1859) 87.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38865 !); Lawrence Gdns. (Parker 22429 !); Changa Manga (Parker 14871 !, 14870 !); Amritsar—Ram Bagh (Parker 4479 !, 22430 !); Kangra (Parker 22438 !); Gurdaspur—Madhopur (Parker 14342 !, 14343 !, 14344 !, 14339 !, 14340 !, 14341).
Flowers.—November-May.
Distribution.—Australia.

355. **Eucalyptus Leucoxylon** F. Muell. in Trans. Vict. Inst. I (1855) 33.

Locality.—Lahore (Parker 4439 !); Lawrence Gdns. (* Parker 22470 !).
* Seedling from Vilmorin's seed.
Distribution.—Australia.

356. **Eucalyptus microcorys** F. Muell. Fragm. II, 50.

Locality.—Lahore—Lawrence Gdns. (Parker 22483 !).
Distribution.—Australia.

357. **Eucalyptus hemiphloia** F. Muell. Fragm. II, 62.

Locality.—Lahore—(Parker 22492 !); Ag. Hort. Gdns. (Parker 38668 !); Lawrence Gdns. (Parker 22491 !); Kot. Lakhpat (Parker 14338 !, 14345 !).
Distribution.—Australia.

358. **Eucalyptus siderophloia** Benth. Fl. Austral III, 220.

Locality.—Lahore—(** Parker 4454 !; Changa Manga—Parker 5956 !, 4478 !, 22477 !); Lawrence Gdns. (*Parker 22478 !).
Flowers.—April.
* Seedling from Vilmorin's seed.
** Seedling from Australian seed.
Distribution.—Australia.

359. **Eucalyptus Kirtoniana** F. Muell. Eucalyptogr. DEC. I (1879) in obs.; Sub. E. resinifera.

Locality:—Lahore (* Parker 22506, 6112 !, ** 4457 !; Lawrence Gdns. * Parker 22505 !, 22504 !).
Flowers.—December.
* From sucker shoots. ** Seedling from Australian seed.
Distribution.—Australia.

360. **Eucalyptus patentinervis** R. T. Baker in Proc. Linn. Soc. N. S. Wales XXIV—602.

Locality.—Lahore (* Parker 22461 !).
* Seedlings from Australian seed.
Distribution.—Australia.

361. **Eucalyptus rudis** Endl. in Enum Pl. Hueg. 49.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 6377 !, 38842 !, 38841 !); (* Mustoe 580 !).
Flowers.—August.
* Sown spring 1911. Flower buds September 1913.
Distribution.—Australia.

362. **Eucalyptus rostrata** Schlecht in Linnaea XX (1847) 665.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38771 !, 38844 !, *38665 !), Lawrence Gdns. (Parker 22447 !, 22448 !).
Flowers.—May-August.
* Seed from France as 'Foeld Bay'.
Distribution.—Australia.

363. **Eucalyptus platyphylla** F. Muell in Journ. Linn. Soc. (1859) 93.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 21039 !, 38682 !); Changa Manga (Parker 19340 !).
Flowers.—April-May.
Distribution.—Australia.

364. **Eucalyptus microtheca** F. Muell in Journ. Linn. Soc. III, (1858) 87.

Locality.—Lahore—Lawrence Gdns. (Parker 22469 !); Changa Manga (Parker 17184 !, 17183 !, 17182 !, 17181 !, 17180 !).
Flowers.—July-August.
From seed supplied by the Bot. Gdns. Sydney.
Distribution.—Australia.

365. **Eucalyptus polyanthemos** Schau. in Walp. Rep. II, 924.

Locality.—Lahore—Lawrence Gdns. (* Parker 22468 !; 4438 !).
From Vilmorin's seed.
Distribution.—Australia.

366. **Eucalyptus melanophloia** F. Muell. in Journ. Linn. Soc. III (1859) 93.

Locality.—Lahore—Lawrence Gdns. (Parker 22442 !); Changa Manga (Parker 22443 !, 22444 !, 44771 !).
Flowers.—May.
Distribution.—Australia.

367. **Eucalyptus tereticornis** Sm. Bot. N. Holl. 41.

Locality.—Lahore—Lawrence Gdns. (Parker 6150 !); Ag. Hort. Gdns. (Parker 38843 !, 38693 !); Changa Manga (Parker 22456 !).
Flowers.—April-August.
Distribution.—Australia.

368. **Eucalyptus paniculata** Sm. in Trans. Linn Soc. III (1797) 287.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 3868 !); Changa Manga (Parker 22422 !, 22421 !, 5957 !); Kot Lakhpat (Parker 14868 !).
Flowers.—February-May.
Distribution.—Australia.

369. **Eucalyptus loxophleba** Benth. Fl. Austral. III, 252.

Locality.—Lahore—Lawrence Gdns. (* Parker 22485 !, 4451 !).
* Seedling from Australian seed.
Distribution.—Australia.

370. **Eucalyptus ochrophloia** F. Muell. Fragm. XI. 36.

Locality.—Lahore—(Parker 4452 !); Ag. Hort. Gdns. (Parker 38683 !, 38684 !).
Flowers.—May.
* Seedling from Australian seed.
Distribution.—Australia.

371. **Eucalyptus oleosa** F. Muell. Fragm. II, 56.

Locality.—Lahore (* Parker 4453 !); Ag. Hort. Gdns. (Parker 1544 !).
* Seedling from seed from W. Australia Forest Dept.
Flowering 4 ft. high.
Distribution.—Australia.

372. **Eucalyptus citriodora** Hook. in Mitch. Journ. Trop. Austral. 235.

Locality.—Lahore—Lawrence Gdns. (Parker 22489 !).
Flowers—May.
Distribution.—Australia.

373. **Eucalyptus platypus** Hook. Ic. Pl. t. 849.

Locality.—Lahore—Ag. Hort. Gdns. (* Parker 11546 !).
Flowers.—February; flowering 3 ft. high.
Distribution.—Australia.

374. **Eucalyptus redunca** Schau. in Lehm. Pl. Preiss I, 127.

Locality.—Lahore (* Parker 22471 !, 4442 !).
* Seedling from seed from Vilmorin.
Distribution.—Australia.

375. **Eucalyptus resinifera** Sm. in White, Journ. Voy. N.-S. Wales 231.

Locality.—Lahore—Lawrence Gdns. (* Parker 22480 !).
Distribution.—Australia.

376. **Eucalyptus salmonophloia** F. Muell. Fragm XI, 11.

Locality.—Lahore (* Parker 4441 !).
* Seedling from Australian seed.
Distribution.—Australia.

377. **Eucalyptus salubris** F. Fragm. XI, II.

Locality.—Lahore (Parker 22460 !, 22496 !, 4443 !).
Seedling from Australian seed.
Distribution.—Australia.

378. **Eucalyptus Trabuti** Vilm.

Locality.—Lahore—Ag. Hort. Gdns. (Gdns. Overseer 39760 !, 39761 !, 39762 !, 39763 !); (Parker 38866 !; 38772 !; 38770 !); Lawrence Gdns. (* Parker 22465 !).
Flowers.—April-August.
* Seedling from Vilmorin's seed.

379. **Eucalyptus uncinata** Turcz. in Bull. Soc. Nat. Mosc. XXII (1849) II, 23.

Locality.—Lahore (* Parker 4437 !).
* Seedling from Vilmorin's seed.
Distribution.—Australia.

380. **Eucalyptus populifolia** Hook. Ic. Pl. t. 879.

Locality.—Lahore—Lawrence Gdns. (* Parker 22487 !, 22486 !, 4449 !).
Seedling from Australian seed.
Distribution.—Australia.

381. **Eucalyptus exerta** F. Muell in Journ. Linn. Soc. III (1859) 85.

Locality.—Lahore (Parker 22463 !, 4459 !).
Seedling from Australian seed.
Distribution.—Australia.

382. **Eucalyptus melliodora** A. Cunn. ex Schau in Walp. Rep. II, 924.

Locality.—Lahore—Lawrence Gdns. (Parker 22484 !).
Distribution.—Australia.

182. PSIDIUM *L.*

383. **Psidium cattleianum** Sabine in Trans. Hort. Soc. IV, 1822, 317. t. 11.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13725 !).
Flowers.—April.
Distribution.—Brazil.

384. **Psidium pumilum** Vahl. Symb. Bot. II, 56.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13668 !, 15046 !).
Flowers.—May.
Distribution.—Tropical America.

183. MYRTUS *L.*

385. **Myrtus communis** L. Sp. Pl. (1753) 471.

Locality.—Rawalpindi (Ait. 403 !).
Flowers.—May.
Distribution.—A native of S. Europe.

184. EUGENIA *L.*

386. **Eugenia Jambolana** Lam. Encyc. III Method (1789) 198.

Locality.—Rawalpindi (Ait. 124 !).
Flowers.—August.
Distribution.—Ceylon ; Malaya ; Australia. Throughout India.

387. **Eugenia bracteata** Roxb. Hort. Beng. (1814) 37.

Locality.—Lahore—Ag. Hort. Gdns. (6779 ! ; Parker 13116 !).
Flowers.—April. *Fruits.*—December.
Distribution.—S. India. Ceylon.

388. **Eugenia uniflora** L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13737 !).
Fruits.—April.
Distribution.—A native of S. America, becoming naturalized in Ceylon and parts of India.

XLVII. LYTHRACEAE.

185. AMMANNIA *L.*

389. **Ammannia baccifera** L. Sp. Pl. (1762) 175.

Locality.—Hoshiarpur (Ait. 611 !).
Distribution.—Tropical Africa; Afghanistan; Ceylon; China; Malaya; Australia. Throughout India in moist places.

186. WOODFORDIA *SALISB.*

390. **Woodfordia floribunda** Salisb. Parad. Lond. (1806) t. 42.

Locality.—Dalhousie (Drum's Hort. 296 !); Rawalpindi (Ait. 404 !).
Flowers.—March.
Distribution.—Tropical Africa; Madagascar; China; Japan; Sumatra. Throughout India. Ceylon; Baluchistan.

187. NESAEA *COMM.*

391. **Nesaea myrtifolia** Chas.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13132 !, 6778 !, 6777 !, 13788 !).
Flowers.—May.
Distribution.—Brazil.

188. LAWSONIA *L.*

392. **Lawsonia alba** Lamk. Ill. t. 296, fig. 2.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13671 !); Multan (Monro 312 !).
Flowers.—April-June.
Distribution.—Kabul; Persia. Cultivated in many tropical and warm temperate regions. Throughout India, very common, cultivated; perhaps wild in W. India.

189. LAGERSTROEMIA *L.*

393. **Lagerstroemia Flos-Reginae** Retz. Obs. V. 25.

Locality.—Gurdaspur (Fane 4857 !).
Flowers.—June.
Distribution.—Malaya, China. India—from Bombay southwards.

394. **Lagerstroemia floribunda** Jack. in Mal. Misc. I, 38.

Locality.—Lahore—Ag. Hort. Gdns. (Porder 38831 !, *14365 !).
Flowers.—August-October.
* Colour—rose fading to white.
Distribution.—Siam; Malaya; China.

395. **Lagerstroemia anisoptera** Koehne.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38634 !, 37122 !).
Flowers.—January-May; Colour white.

XLVIII. ONAGRACEAE.

190. EPILOBIUM L.

396. **Epilobium roseum** Schreb.

Locality.—Rawalpindi (Ait. 71 !).
Flowers.—September.
Distribution.—West Asia; Europe. India—temperate Himalaya, at 5-11,000 ft., common.

191. Trapa *L.*

397. **Trapa bispinosa** Roxb. Cor. Pl. 234.

Variety.—*incisa* Wall.
Locality.—Hoshiarpur (Ait. 422 !).
Distribution.—S.-E. Asia, Malaya, Tropical Africa. Throughout India cultivated. Ceylon.

XLIX. SAMYDACEAE.

192. Casearia *JACQ.*

398. **Casearia tomentosa** Roxb. Fl. Ind. II (1832) 421.

Locality.—Hoshiarpur (Ait. 503 !).
Distribution.—Ceylon ; Malaya ; N. Australia. Throughout India.

L. PASSIFLORACEAE.

193. Passiflora *L.*

399. **Passiflora lunata** Willd. Sp. Pl. III, 612.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 15038 !).
Flowers.—October.
Distribution.—Tropical America.

400. **Passiflora caerulea-racemosa** Sab.

Locality.—Lahore—Changa Manga (Parker 19327 !).
Flowers.—May ; Purple.
Cultivated.

LI. CUCURBITACEAE.

194. Trichosanthes *L.*

401. **Trichosanthes cucumerina** L. Sp. Pl. (1753) 1008.

Locality.—Hoshiarpur (Ait. 509).
Distribution.—Ceylon ; Malaya ; N. Australia. Throughout India.

195. Momordica *L.*

402. **Momordica dioica** Roxb. Fl. Ind. III, 709.

Locality.—Rawalpindi (Ait. 408 !, 196 !, 195 !, 194 !) ; Hissar (Duthie 4036 !).
Flowers.—July-September.
Distribution.—Ceylon ; Malaya Throughout India.

196. Cucumis *L.*

403. **Cucumis trigonus** Roxb. Fl. Ind. II, 722.

Locality.—Rawalpindi (Ait. 192 !).
Flowers.—September.
Distribution.—Ceylon ; Malaya ; N. Australia ; Afghanistan ; Persia. Throughout India.

404. **Cucumis Melo** L. Sp. Pl. (1753) 1011.

Locality.—Rawalpindi (Ait. 4091).
Flowers.—July-September.
Distribution.—Throughout India cultivated. Cultivated in most hot countries.

197. Citrullus *SCHRADER.*

405. **Citrullus Colocynthis** Schrader in Linnaea V. 12 (1838) 414.

Locality.—Sandy grounds near Jaito (Duthie 4034 !).
Flowers.—August.
Distribution.—Ceylon; W. Asia; Arabia; Baluchistan. Throughout India, wild or sparingly cultivated.

406. **Citrullus vulgaris** Schrader in Linnaea 1848, 412.

Locality.—Rawalpindi (Ait. 410 !); Lahore (2943 Brandis Herb).
Flowers.—July.
Distribution.—Throughout India, cultivated. In all warm countries of the world, cultivated.

198. Cephalandra *SCHRADER.*

407. **Cephalandra indica** Naud. in Ann. Sc. Ser. 5, V, 16.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38822 !).
Flowers.—August.
Naturalized in these gardens.
Distribution.—Malaya, Africa. Throughout India, common.

LII. CACTACEAE.

199. Opuntia *TOURN.*

408. **Opuntia Dillenii** Haw. Suppl. Pl. Succ. 79.

Locality.—Rawalpindi (Ait. 1067 !).
Flowers.—February.
Distribution.—S. America.

LIII. FICOIDEAE.

200. Trianthema *L.*

409. **Trianthema crystallina** Vahl. Symb. I, 32.

Locality.—Multan 31 !; Lahore (Cleghorn 2646 !; Stewart 2900). Rawalpindi—on salt ground (Ait. 580 !).
Flowers.—October.
On clayey hard soil. Fodder for goats.
Distribution.—Throughout Africa. India—Punjab.

410. **Trianthema pentandra** L. Mant. 79.

Locality.—Hissar (Duthie 4041 !); Lahore (2662 ! Brandis Herb); Multan (Monro 201 !). Rawalpindi (Ait. 411 !, 412 !).
Flowers.—April-August.
Distribution.—Tropical Africa. India—Punjab, N.-W. Provinces, Sind, W. Peninsula.

201. Mollugo *L.*

411. **Mollugo hirta** Thunb. Fl. Cap. 120.

Locality.—Lahore (Stewart 2566 !); Hoshiarpur (Ait. 605 !); Multan (Monro 233 !).
Flowers.—March.
Distribution.—Throughout India, common. Ceylon; warmer regions of the world.

412. **Mollugo nudicaulis** Lamk. Dict. IV, 234.

Locality.—Multan (Monro 31 !, 232 !); Rawalpindi—Barrakow (Ait. 413 !).
Flowers.—October.
Distribution.—Ceylon; New Caledonia; Tropical Africa and Cuba. India—Punjab and hotter and drier parts.

LIV. UMBELLIFERAE.

202. Carum *L.*

413. **Carum Bulbocastanum** G. D. J. Koch. in Nov. Ait. Acad. Caes. Leop. (1825) 121.

Locality.—Peshawar—College (Quizilbash 55 !).
Distribution.—Baluchistan; N. Asia; Europe; N. Africa.

414. **Carum anethifolium** Benth. in gen. Pl. I, 89.

Locality.—Dalhousie (179 ! Drum's Herb.).
Distribution.—India—Almora, alt. 5,000 ft.; Nepal.

203. Anethum *TOURN.*

415. **Anethum graveolens** L. Sp. Pl. 263.

Locality.—Lahore (Stewart 2546 !).
Distribution.—Cultivated in S. Europe and W. Asia. Throughout tropical and subtropical India.

204. Foeniculum *ADANS.*

416. **Foeniculum vulgare** Gaertn. Fruct. I, 105, t. 23, fig. 5.

Locality.—Rawalpindi (Ait. 417 !).
Flowers.—April.
Distribution.—Commonly cultivated throughout India, alt. 0-6,000 ft., often appearing wild.

205. Oenanthe *L.*

417. **Oenanthe stolonifera** Wall. Cat. 585.

Locality.—Rawalpindi (Ait. 118 !).
Flowers.—September.
Distribution.—Java; China and Japan. Northern India from Kashmir and the Punjab to Assam, alt. 0-5,000 ft. frequent; common in the plains of Bengal.

206. Heracleum *L.*

418. **Heracleum candicans** Wall. Cat. 573.

Locality.—Dalhousie (Drum 328 !); Kangra (Jamesan 3354 !).
Flowers.—February.
Distribution.—India—Kashmir to Kumaon alt. 6-12,000 ft., common.

207. Coriandrum *L.*

419. **Coriandrum sativum** L.

Locality.—Rawalpindi (Ait. 414 !); Lahore (Stewart 2547 !).
Flowers.—March.
Distribution.—Throughout India, cultivated.

208. Caucalis *L.*

420. **Caucalis leptophylla** L.

Locality.—Peshawar College (Quizilbash 18 !).
Distribution.—W. Asia; S. Europe; N. Africa. India—Punjab.

209. Psammogeton *EDGW.*

421. **Psammogeton biternatum** Edgew. in Trans. Linn. Soc. XX, 57.

Locality.—Lyallpur—(Inayat !).
Distribution.—Baluchistan; Kabul; Persia. India—Punjab, Sind.

422. **Psammogeton canescens** Valke.

Locality.—Peshawar (1028 !); Lahore (2904).
Flowers.—March-April.

LV. ARALIACEAE.

210. Heptapleurum *GAERTN.*

423. **Heptapleurum venulosum** Seem. Rev. Heder. 44.

Locality.—Hoshiarpur (Ait.).
Distribution.—Malaya; Tropical Australia. Throughout India.

211. Hedera *L.*

424. **Hedera Helix** L.

Locality.—Rawalpindi (Ait. 138 ! alt. 5000); Patiala State (Jannujee 10 !).
Distribution.—W. Europe to Japan.

LVI. CORNACEAE.

212. Cornus *L.*

425. **Cornus oblonga** Wall. Roxb. Fl. Ind. ed. Carey & Wall. I, 432.

Locality.—Rawalpindi—Dhirkot alt. 3500-4500 (Jerram 7475 ! 7474 !, 7473 !, 7354 !).
Flowers.—March.
Distribution.—India—Jhelum to Nepal, alt. 4-7,000 ft. frequent; Bhutan.

LVII. CAPRIFOLIACEAE.

213. Viburnum *L.*

426. **Viburnum cotinifolium** Don. Prodr. 141.

Locality.—Dalhousie (4627 ! Drum's Herb.).
Distribution.—India—Kashmir to Kumaon alt. 6-11,000 ft.

427. **Viburnum stellulatum** Wall. Pl. As. Rar II, 54, t. 169.

Locality.—Dalhousie (4626 ! Drum's Herb.); Rawalpindi alt. over 6,000 ft. (Jerram 8269 !).
Flowers.—July.
Distribution.—India—Temp. Himalaya alt. 6-11,000 ft., Kashmir to Sikkim, common.

428. **Viburnum coriaceum** Blume. Bijd., 656.

Locality.—Rawalpindi—alt. 3,500-4,500 ft. (Jerram—7469 !, 7470 !).
Flowers.—March.
Distribution.—Java. India—Temperate Himalaya; N. Burma.

214. Lonicera *L.*

429. **Lonicera quinquelocularis** Hardwick in As. Res. VI, 351.

Locality.—Rawalpindi (Jerram 7782 !).
Flowers.—April.
Distribution.—India—temperate Himalayas, Kashmir to Kumaon alt. 8-13,000 ft., frequent.

430. **Lonicera sempervirens** L. Sp. Pl. 173.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 11459 !).
Flowers.—February.
Distribution.—North America.

LVIII. RUBIACEAE.

215. Stephegyne *KORTH.*

431. **Stephegyne parvifolia** Korth in Verh. Gesch. Nat. Bot. 161.

Locality.—Kangra (9739 !).
Flowers.—June.
Distribution.—Throughout drier parts of India. Ceylon.

216. Wendlandia *BARTL.*

432. **Wendlandia exerta** DC. Prodr. IV, 411.

Locality.—Rawalpindi (Lehtrar 9744 !); Kangra (9740 !).
Flowers.—May.
Distribution.—India—dry forests of tropical Himalaya, Orissa, C. India, N. Deccan, Konkan.

433. **Wendlandia puberula** DC. Prodr. IV, 412.

Locality.—Rawalpindi (Alt. 4,300 ft. Jerram, 723 !).
Distribution.—India—dry forests of tropical Himalaya, from Gharwal to Nepal, alt. 0-4,000 ft.).

217. Randia *L.*

434. **Randia tetrasperma** Roxb. Fl. Ind. I, 709 (Gardenia).

Locality.—Rawalpindi—Seribari 4,500 ft. (Jerram 7891 !).
Distribution.—India—Kashmir and subtropical Himalaya; Sikkim; Bhootan

218. Gardenia *L.*

435. **Gardenia Thunbergia** L. f. Suppl. 162.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13608 !, 13623 !).
Flowers.—June.
Distribution.—South Africa.

219. Pavetta *L.*

436. **Pavetta indica** L. Sp. Pl. (1753) 110.

Locality.—Rawalpindi—Kam Rat (Jerram 6752 !).
Distribution.—Malay Archipelago; S. China; N. Australia. Throughout India.

220. Hamiltonia *ROXB.*

437. **Hamiltonia suaveolens** Roxb. Hort. Beng. 15.

Locality.—Rawalpindi (Ait. 1061 !).
Flowers.—March.
Distribution.—China. India—tropical and subtropical Himalayas, C. India, W. Peninsula.

221. Leptodermis *WALL.*

438. **Leptodermis lanceolata** Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II, 191.

Locality.—Dalhousie (Drum's Herb. 383 !, 384 !).
Distribution.—India—Temperate Himalaya.

439. **Leptodermis parkeri** Dunn. in Kew Bull. 1920, 206.

Locality.—Dalhousie (385 ! Drum's Herb.).
Distribution.—India.

222. SERISSA *COMM.*

440. Serissa foetida Lamk. Illustr. II, 211.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 12962 !).
Flowers.—April.
Distribution.—China, Japan.

223. SPERMACOCE *L.*

441. Spermacoce hispida L. Sp. Pl. (1753) 102.

Locality.—Hoshiarpur (Ait. 606 !).
Distribution.—S. China; Malay Archipelago. Throughout India.

224. GALIUM *L.*

442. Galium Aparine L.

Locality.—Hoshiarpur (Ait. 353 !); Rawalpindi (Ait. 194 !).
Flowers.—March.
Distribution.—Europe; N. Africa; N. and W. Central Asia. India—Temperate Himalaya.

443. Galium tricorne With.

Locality.—Peshawar College (Quizilbash 9 !).
Distribution.—Central and S. Europe, N. Africa; W. Asia. India—Western Himalaya.

LIX. VALERIANACEAE.

225. FEDIA *GAERTN.*

444. Fedia sclerocarpa Fisch. & Mey.

Locality.—Hoshiarpur (*Ait. 628 !).
* A common garden weed at Hoshiarpur, Jhelum and Rawalpindi.

LX. DIPSACEAE.

226. SCABIOSA *L.*

445. Scabiosa Olivieri Coult. Dips. 36 t. 2, fig. 10.

Locality.—Rawalpindi (Ait. 425 !).
Flowers.—April.
Distribution.—Afghanistan to Armania and Arabia. India—W. Punjab.

LXI. COMPOSITAE.

227. VERNONIA *SCHREB.*

446. Vernonia cinerea Less. in Linnaea IV, 291, and VI, 673.

Locality.—Rawalpindi (Ait. 203 !).
Flowers.—September.
Distribution.—Tropical Asia, Africa, Australia. Throughout India.

228. EUPATORIUM *L.*

447. Eupatorium conyzoides Vahl. Symb. Bot. III, 96.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14846 !; 13726 !).
Flowers.—May.
Seed from Mexico. Large perennial, more or less shrubby below, and grows vigorously.
Distribution.—Tropical and N. America.

229. SOLIDAGO *L.*

448. Solidago Virga-aurea L.

Locality.—Dalhousie (387 ! Drum's Herb.).
Distribution.—Europe; Temperate Asia and America; Hongkong. India—Temperate Himalaya.

230. CYATHOCLINE *CASS.*

449. Cyathocline lyrata Cass. in Ann. Sc. Nat., Ser. I, XVII. (1829) 420.

Locality.—Lahore—Ag. Hort. Gdns. (*Parker 21711); Rawalpindi (Ait. 459 !).
Flowers.—November.
* Weed in moist places.
Distribution.—India.

231. GRANGEA *FORSK.*

450. Grangea maderaspatana Poir. Encyc. Method. Suppl. V. (1811) 825.

Locality.—Gurdaspur (453 ! Drum's Herb).
Distribution.—Ceylon; tropical and subtropical Asia and Africa. Throughout India.

232. MYRIACTIS *LESS.*

451. Myriactis nepalensis Less.

Locality.—Dalhousie (411 ! Drum's Herb.).
Distribution.—Central Asia. India—Temperate Himalaya.

233. ASTER *L.*

452. Aster Thomsoni Clarke Comp. Ind. 48.

Locality.—Dalhousie (389 ! Drum's Herb.).
Distribution.—India—W. Himalaya.

234. ERIGERON *L.*

453. Erigeron linifolius Willd. Sp. Pl. III, 1955.

Locality.—Rawalpindi (Ait. 126 !).
Flowers.—June. Weed.
Distribution.—Caledonia.

454. Erigeron canadensis L.

Locality.—Rawalpindi (Ait. 198 !); Lahore—Changa Manga (Monro !).
Flowers.—August-September.
Distribution.—All warm countries; Assumed to be a native of N. America. India—W. Himalaya and the Punjab.

455. Erigeron alpinus L.

Locality.—Dalhousie (394 ! Drum's Herb.).
Distribution.—Mountains of the N. Temperate Zone. India—throughout the temperate and Alpine W. Himalaya.

235. BLUMEA *DC.*

456. Blumea Wightiana DC. in Wight Contrib. 14.

Locality.—Peshawar College (Quizilbash 351 !); Rawalpindi (Ait. 1073 !).
Distribution.—Malay Islands; China; Australia; tropical Africa. Throughout the plains of India.

236. LAGGERA *SCH. BIP.*

457. **Laggera aurita** Schultz-Bip. in Herb. Hohenack.

Locality.—Lahore (2936 !).
Flowers.—April.
Distribution.—Tropical Africa. Throughout the plains of India.

237. PLUCHEA *CASS.*

458. **Pluchea lanceolata** Oliv. Fl. Trop. Afr. III, 329.

Locality.—Lahore—Changa Manga (Kanji Lal 1122 !); Lahore—(Parker 9724 !; Stewart 2555 !); Rawalpindi (Ait. 427 !).
Flowers.—January-May-June.
Distribution.—Afghanistan; Baluchistan; N. Africa. India.

238. FILAGO *L.*

459. **Filago germanica** L.

Locality.—Rawalpindi (Ait. 437 !); Hoshiarpur (Ait. 346 !); Lyallpur (Inayat !); Lahore (Stewart 2564 !).
Flowers.—March-April.
Distribution.—India—Plains and Mountains of N.-W. Provinces. Westwards to Canaries.

239. IFLOGA *CASS.*

460. **Ifloga Fontanesii** Cass. in Dict. Sc. Nat. XXIII, 14.

Locality.—Rawalpindi—Hoshiarpur (Ait. 1071 !); Lahore (Stewart 2569 !).
Flowers.—March.
Distribution.—India—Upper Gangetic Plains, from Saharanpur to the Frontier. Westwards to Canaries.

240. LEONTOPODIUM *Br.*

461. **Leontopodium alpinum** Cass.

Locality.—Dalhousie (15302 Drum's Herb.).
Distribution.—Alps of Europe and Central Asia. India-Alpine Himalaya.

241. GNAPHALIUM *L.*

462. **Gnaphalium luteo-album** L.

Locality.—Rawalpindi (Ait. 43 !, 135 !).
Flowers.—February-March.
Distribution.—Most hot and warm temperate countries. Throughout India.

242. CAESULIA *ROXB.*

463. **Caesulia axillaris** Roxb. Hort. Beng. 62.

Locality.—Hoshiarpur (Ait. 609 !).
Distribution.—Throughout Northern India.

243. INULA *L.*

464. **Inula Cappa** DC. Prodr. V, 469.

Locality.—Rawalpindi (Lehtrar 9719).
Flowers.—May.
Distribution.—Java; China. India—Temperate Himalaya.

244. VICOA *CASS*

465. **Vicoa vestita** Benth. in Gen. Pl. II, 335.

Locality.—Rawalpindi (Ait. 428 !); Lahore (Stewart 2923 !, 2924 !, 2928 !, 2557 !, 2558 !, 2559 !).
Flowers.—April-May.
Distribution.—Afghanistan. Drier parts of India.

245. PULICARIA *GAERTN.*

466. **Pulicaria crispa** Benth, in Gen. Pl. II, 336.

Locality.—Lahore—Kot Lakhpat (Parker 17178!, 17179!, 17197!); Rawalpindi (Ait. 434!); Lahore (Stewart 2556!, 2609!).
Flowers.—March-May.
Distribution.—Arabia; Africa; the Canary and Cape Verde Islands. India—the Punjab, Upper Gangetic Plain and eastwards to Bihar.

246. XANTHIUM *L.*

467. **Xanthium Strumarium** L.

Locality.—Rawalpindi—Googerkh (Ait. 58!).
Flowers.—June-October.
Distribution.—Throughout the hotter parts of India and Ceylon, usually near houses; ascending in W. Himalaya to 5,000 ft.

247. SIEGESBECKIA *L.*

468. **Siegesbeckia orientalis** L.

Locality.—Dalhousie (15588! Drum's Herb.); Rawalpindi Barrakow (Ait. 431!).
Flowers.—September.
Distribution.—Cosmopolitan in warm climates. Throughout India, ascending to 5,000 ft. in the Himalaya.

248. ECLIPTA *L.*

469. **Eclipta alba** Hassk.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 38817!); Dalhousie (15591! Drum's Herb.); Lahore—(3003! Brandis Herb.; Stewart 2598!; Cleghorn 2650!).
Flowers.—August-October.
Distribution.—Cosmopolitan in warm climates. Throughout India, ascending to 6,000 ft. in the Himalaya.

249. BLAINVILLEA *CASS.*

470. **Blainvillea latifolia** DC. Wight Contrib. 17.

Locality.—Rawalpindi (Ait. 200!).
Flowers.—September.
Distribution.—Ceylon; tropical Asia; Africa and Australia. W. India and Deccan ascending to 5,000 ft. in Kumaon.

250. CENIA *JUSS.*

471. **Cenia turbinata** Pers. Syn. II, 465.

Locality.—Hoshiarpur (Ait.).
Probably an escape. An African type.
Distribution.—South Africa.

251. CENTIPEDA *LOUR.*

472. **Centipeda orbicularis** Lour. Fl. Coch.

Locailty.—Hoshiarpur (Ait. 637!).
Distribution.—Ceylon; Afghanistan; E. tropical Asia; Australia and the Pacific Islands. Throughout the plains of India in moist places.

252. ARTEMISIA *L.*

473. **Artemisia scoparia** Waldst. & Kit. Pl. Rar. Hung, I, 66, t. 65.

Locality.—Rawalpindi (Ait. 582!).
Flowers.—October.
Distribution.—Japan; Afghanistan to Central Europe. India—Upper Gangetic Plain and westwards to Sind and the Punjab, W. Himalaya, 5-7,000 ft.

253. SENECIO *L.*

474. **Senecio Coronopifolius** Desf.

Locality.—Rawalpindi (Ait. 1069 !).
Flowers.—March.
Distribution.—Afghanistan and westwards to Spain. India—W. Himalaya.

254. ECHINOPS *L.*

475. **Echinops echinatus** DC. in Wight Contrib. 24.

Locality.—Lahore (2627 ! ; Stewart 2590 !).
Flowers.—March-April.
Distribution.—Afghanistan. India—Upper Gangetic Plain, N.-W. Himalaya, the Punjab, Bihar, Sind, Rajputana, the Deccan.

255. COUSINIA *CASS.*

476. **Cousinia minuta** Boiss. Fl. Orient. III, 489.

Locality.—Peshawar College (Quizilbash 41 !) ; Rawalpindi (Ait. 441 !).
Flowers.—May.
Distribution.—Afghanistan ; Baluchistan and Persia. India—the Punjab.

256. CNICUS *L.*

477. **Cnicus arvensis** Hoffm.

Locality.—Peshawar—College (Quizilbash 7 !) ; Lahore (2926 ! Brandis Herb ! ; Stewart 2608 !).
Flowers.—March-April.
Distribution.—N. Asia and westwards to the Atlantic. India—Bengal, Gangetic Plains, the Punjab, W. Himalaya.

478. **Cnicus argyracanthus** DC. Prodr. 640 (*Cirsium*).

Locality.—Gurdaspur—Seya-purkandi (Bisram 839 !).
Flowers.—May.
Distribution.—India—Temperate Himalaya.

257. SAUSSUREA *DC.*

479. **Saussurea candicans** Clarke Comp. Ind. 232.

Locality.—Hoshiarpur (Ait. 580 !).
Distribution.—Afghanistan. Subtropical and temperate W. India and the Himalaya.

480. **Saussurea albescens** Hook f. & T. in Clarke Comp. Ind. 233.

Locality.—Dalhousie (15593 ! Drum's Herb.).
Distribution.—India—W. and C. Himalaya.

258. VOLUTARELLA *CASS.*

481. **Volutarella divaricata** Benth. in Gen. Pl. II, 476, excl. some syns.

Locality.—Lahore (Stewart 2591 !, 2505 !).
Distribution.—Afghanistan ; Baluchistan. India.

259. CENTAUREA *L.*

482. **Centaurea cyanus** L.

Locality.—Rawalpindi (* Ait. 440 !).
Flowers.—April.
* May be an escape from gardens.
Distribution.—Caucasus and westwards to Atlantic. In corn fields and cultivated places of N.-W. India, sporadic.

483. **Centaurea Calcitrapa** L.

Locality.—Peshawar—College (Quizilbash 33 !).
Distribution.—W. Asia and Europe, introduced in most parts of the world. N.-W. India.

260. CARTHAMUS *L.*

484. **Carthamus oxyacantha** Bieb.

Locality.—Multan (Monro 401 !); Rawalpindi (Ait. 443 !).
Flowers.—May.
Distribution.—India—the Punjab. Westwards to Caucasus. Perhaps a wild form of the Safflower, *C. tinctorius* (Clarke).

261. GERBERA *GRONOV.*

485. **Gerbera lanuginosa** Benth. in Gen. Pl. II, 497.

Locality.—Rawalpindi (Ait. 134 !).
Flowers.—August.
Distribution.—India—W. Himalaya.

262. CICHORIUM *L.*

486. **Cichorium Intybus** L.

Locality.—Lahore (Stewart 2604 !); Peshawar College (Quizilbash 51 !).
Flowers.—April.
Distribution.—N.-W. India. Westwards to the Atlantic.

263. KOELPINIA *PALL.*

487. **Koelpinia linaria** Pall.

Locality.—Peshawar (Quizilbash 43 !); Rawalpindi (Ait. 1071 !, 439 !).
Flowers.—May.
Distribution.—C. and W. Asia, N. Africa, S. Russia. India—the Punjab, Kashmir.

264. CREPIS *L.*

488. **Crepis foetida** L.

Locality.—Rawalpindi (Ait. 429 !).
Flowers.—April.
Distribution.—India—the Punjab and W. Himalaya. Westwards to Atlantic.

489. **Crepis japonica** Benth. Fl. Hongk. 194.

Locality.—Hoshiarpur (Ait. 496 !).
Distribution.—Ceylon; Malay Peninsula; China; Japan; Afghanistan; Mauritius. Throughout India.

265. LACTUCA *L.*

490. **Lactuca dissecta** Don. Prodr. 164.

Locality.—Rawalpindi (Ait. 457 !, 450 !, 452 !).
Flowers.—March-April.
Distribution.—Afghanistan; Baluchistan. India—Temperate Himalaya.

266. PICRIDIUM *DESF.*

491. **Picridium tingitatum** Desf. Bois. Fl. Orient. III, 827.

Locality.—Rawalpindi (Ait. 1070 !).
Distribution.—Afghanistan; Baluchistan; Persia; Arabia; and N. Africa to the Canaries, S. Europe. India—the Punjab.

267. SONCHUS *L.*

492. **Sonchus oleraceus** L.

Locality.—Rawalpindi (Ait. 447 !).
Flowers.—April.
Distribution.—Throughout India.

493. **Sonchus arvensis** L.

Locality.—Rawalpindi (Ait. 445 !, 202 !, 149 !, 448 !) ; Lahore (Brandis 2608 !).
Flowers.—March-September.
Distribution.—Throughout India.

268. LAUNAEA *CASS.*

494. **Launaea asplenifolia** DC. Prodr. VII, 181 (*Microrhynchus*).

Locality.—Lahore (Stewart 2611).
Flowers.—April.
Distribution.—Plains of India.

495. **Launaea chondrilloides** DC. Prodr. VII, 183 (*Zollikoferia*).

Locality.—Rawalpindi (Ait. 455 !).
Flowers.—March-April.
Distribution.—Afghanistan ; Persia ; Arabia ; Egypt. India—Punjab, Sind Rajputana.

496. **Launaea nudicaulis** Less. Synops. 139 (*Microrhynchus*).

Locality.—Peshawar, College (Quizilbash 31 !) ; Lahore (2920 ! Brandis Herb.) ; * Multan (281) ; Lahore (Stewart 2842 !, 2563 !) ; Phaltal (15 !) ; Rawalpindi (Ait. 454 !).
Flowers.—March-April.
* Grows on sandy soil. Fodder for goats only. Used here also as medicine for eyes.
Distribution.—Afghanistan and westwards to the Atlantic. Plains of India.

LXII. CAMPANULACEAE.

269. CAMPANULA *L.*

497. **Campanula canescens** Wall. Cat. 1289.

Locality.—Lahore (Stewart 2826 !) ; Hoshiarpur (Ait. 354 !) ; Rawalpindi (Ait. 460 !).
Flowers.—March.
Distribution.—Throughout India. Ceylon.

498. **Campanula colorata** Wall. Cat. 1287.

Locality.—Dalhousie (13907 !, 13908 ! Drum's Herb.).
Distribution.—Kabul. India—temperate Himalaya 3-10,000 ft. Western Ghats 5-7,000 ft.).

LXIII. ERICACEAE.

270. PIERIS *D.DON.*

499. **Pieris ovalifolia** D.Don in Edinb. Phil. Journ. XVII (1834), 159.

Locality.—Dalhousie (4701 ! Drum's Herb.).
Distribution.—Japan. India—temperate Himalaya ; Burma.

LXIV. PLUMBAGINACEAE.

271. PLUMBAGO *L.*

500. **Plumbago capensis** Thunb. Prodr. Pl. Cap. 33.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13115 !).
Flowers.—April.
Distribution.—S. Africa.

LXV. PRIMULACEAE.

272. PRIMULA *L.*

500. **Primula erosa** Wall. Cat. 611.

Locality.—Dalhousie (13917 !, 13916 ! Drum's Herb.).
Distribution.—India—temperate Himalaya, alt. 4,500-9,500 ft.

273. ANDROSACE *L.*

502. **Androsace saxifragaefolia** Bunge Enum. Pl. Chin. Bor. 53.

Locality.—Hoshiarpur (Ait. 500 !).
Distribution.—N.-E. China; Japan; Loochoo Islands. India—Gangetic Plains to the Punjab and ascending the Himalayas to 4,000 ft.

503. **Androsace lanuginosa** Wall. in Roxb. Fl. Ind. ed. Wall. & Carey, II, 15.

Locality.—Dalhousie (13914 ! Drum's Herb.).
Distribution.—India—W. Himalaya.

274. ANAGALLIS *TOURNEF.*

504. **Anagallis arvensis** L.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 21019 !, 20999 !); Rawalpindi 8,000 ft. (Ait. 461 !).
Flowers.—March-October.
Distribution.—Ceylon; Europe; W. Asia and introduced into most temperate regions. India—Bengal, N.-W. Provinces, Central India, Himalaya, Nilgiri Hills.

LXVI. MYRSINACEAE.

275. MYRSINE *L.*

505. **Myrsine semiserrata** Wall. in Roxb. Fl. Ind. ed. Carey & Wall. II, 293.

Locality.—Rawalpindi—Charihan 6,000 ft. (Jerram 7784 !, 7783 !).
Flowers.—April.
Distribution.—Himalayas, Burma.

276. ARDISIA *SWARTZ.*

506. **Ardisia solanacea** Roxb. Cor. Pl. 27. t. 27.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 13143 !, 13144 !).
Flowers.—May.
Distribution.—Ceylon, Malaya, China. Throughout India, alt. 0-5,000 ft.

507. **Ardisia Pickeringia** Terr. & Gray ex DC. Prodr. VIII, 124.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14368 !, 11454 !).
Flowers.—November-February.
Distribution.—Philippine Islands.

277. REPTONIA *A.DC.*

508. **Reptonia buxifolia** A. DC. Prodr. VIII, 153.

Locality.—Peshawar—Nizampur (8219 !).
Distribution.—Afghanistan; Muscat.

LXVII. SAPOTACEAE.

278. MIMUSOPS *L.*

509. **Mimusops Elengi** L.

Locality.—Multan-Harani Bagh (Monro 314 !).
Distribution.—Cultivated in the Tropics. India—Deccan; in N. India frequently cultivated.

510. **Mimusops hexandra** Roxb. Cor. Pl. I, 16, t. 15 and Fl. Ind. II, 238.

Locality.—Multan & Jalalpur (Monro 409!).
Flowers.—June.
Distribution.—India—Deccan common; extending north to Gujrat, Banda and Circars; cultivated in N.-W. India. Ceylon common.

LXVIII. EBENACEAE.

279. Diospyros *L.*

511. **Diospyros cordifolia** Roxb. Cor. Pl. I, 38, t. 50 and Fl. Ind., II, 538.

Locality.—Hoshiarpur (Ait. 563!).
Distribution.—Burma; Malay Archipelago; Tropical Australia.

512. **Diospyros tomentosa** Roxb. Hort. Beng. 40 and Fl. Ind. II, 532.

Locality.—Hoshiarpur!.
Fruits.—October.
Distribution.—India.

LXIX. OLEACEAE.

280. Jasminum *L.*

513. **Jasminum Sambac** Ait Hort. Kew I, 8.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6369!).
Flowers.—June.
Distribution.—Much cultivated throughout India and in the Tropics of both hemispheres.

514. **Jasminum pubescens** Willd. Sp. Pl. I, 37.

Locality.—Hoshiarpur (Ait. 596!).
Distribution.—Burma; Ceylon; China. Throughout India.

515. **Jasminum arborescens** Roxb. Hort. Beng. 3 and Fl. Ind. ed. Carey & Wall. I, 94.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 6367!).
Flowers.—May.
Distribution.—Throughout India, in the hot lower hills, alt. 500-3,000 ft., common.

516. **Jasminum rigidum** Zenker Pl. Ind. 5, t. 6.

Locality.—Lahore—Ag. Hort. Gdns. (Mustoe 6380!).
Flowers.—April.
Distribution.—India—Deccan Peninsula. Ceylon.

517. **Jasminum auriculatum** Vahl. Symb. III, 1.

Locality.—Hoshiarpur (Ait. 561!).
Distribution.—Ceylon common; Siam and Mauritius cultivated. India—Deccan Peninsula common, cultivated in Sind, N.-W. India, Bengal.

518. **Jasminum humile** L.

Locality.—Rawalpindi 4,000-6,000 ft. (Jerram 7894!).
Flowers.—May.
Distribution.—Ceylon and Nepal common, Kabul cultivated widely. India—S. India and subtropical Himalaya common, alt. 2-5,000 ft. common.

519. **Jasminum officinale** L.

Locality.—Dalhousie (4844! Drum's Herb.); Rawalpindi 5,000 ft. (Jerram 8091!).
Flowers.—June.
Distribution.—Kabul; Persia; China; Europe, etc. Often cultivated in India.

281. Fraxinus *L.*

520. **Fraxinus oxyphylla** Bieb. Fl. Taur. Cauc. II, 450.

Locality.—Lahore—Ag. Hort. Gdns. (Parker 14247!, 12970!, 13811!, 13664!).
Flowers.—April-May.
Distribution.—Tauria.

282. Olea *L.*

521. **Olea cuspidata** Wall. Cat. 2817.

Locality.—Rawalpindi (P. 5891!, Ait. 205!); Hoshiarpur (Ait. 204!).
Flowers.—September. *Fruits.*—November.
Distribution.—Kabul; Baluchistan. India—N.-W. Himalaya and Kashmir, alt. 2-6,000 ft. frequent.

522. **Olea europaea** L. Sp. Pl. 8.

Locality.—Hoshiarpur (*Parker 14377!); Rawalpindi (Ait. 462!).
Flowers.—July.
* It is 5 ft. in girth near the base but, as in Lahore, gets covered with woolly blight.
Distribution.—Mediterranean region; Orient.

(To be continued)

THE MEDICINAL AND POISONOUS LABIATES OF INDIA.

BY

J. F. CAIUS, S.J., F.L.S.

The LABIATAE are herbs or under-shrubs with stems usually quadrangular bearing the leaves on the flat side. They form a large family of 3,300 species grouped in 200 genera. They are distributed over both hemispheres, especially in temperate regions, being particularly abundant in the Mediterranean area.

This important Order has but few poisonous members, and includes a number of medicinal and sub-medicinal plants of great value. In the lists of drugs supplied to herbalists the Labiates are very strongly represented. They mostly exhibit aromatic or bitter-aromatic, stimulant, and astringent properties; and they are used as tonics, emmenagogues, diaphoretics, and antispasmodics.

Many members yield *essential oils* when distilled. *Alkaloids*—betonicine, stachydrine, turicine—, and *glucosides*—hyssopin—have been isolated.

The medicinal and poisonous Labiates of the world belong to 84 genera :—ACROCEPHALUS (Malay Archipelago to tropical Africa); ACROTOME (southern and tropical Africa); AEOLANTHUS (Africa); AGASTACHE (North America); AJUGA (palaeotemperate regions); AMARACUS (eastern Mediterranean); ANISOCHILUS (Asia, Africa); ANISOMELES (Indo-Malayan region); AUDIBERTIA (North America); BALLOTA (Europe, Mediterranean region; western Asia); BETONICA (cosmopolitan); BRUNELLA (cosmopolitan); CALAMINTHA (northern temperate regions; tropical mountains); COLEBROOKEA (India); COLEUS (palaeotropical regions); CUNILA (America); DRACOCEPHALUM (northern temperate regions); DYSOPHYLLA (eastern Asia, Australia); ELSHOLTZIA (Asia, Europe, Abyssinia); ENDOSTEMON (southern and tropical Africa); EREMOSTACHYS (central and western Asia); ERYTHROCHLAMYS (tropical Africa); GALEOPSIS (northern temperate regions); GENIOSPORUM (Africa, Madagascar, Indo-Malayan region); GLECHOMA (Old World); GLECHON (Brazil, Paraguay); GOMPHOSTEMMA (Indo-Malayan region, China); HEDEOMA (America); HOSLUNDIA (warm Africa); HYMENOCRATER (western Asia); HYPTIS (warm America); HYSSOPUS (Europe, Mediterranean region, Asia); IBOZA (southern and tropical Africa); LALLEMANTIA western Asia); LAMIUM (Europe, Asia, extratropical Africa); LASIOCORYS (Africa); LAVANDULA (Mediterranean region to India); LEONOTIS (tropical and southern Africa); LEONURUS (Europe, Asia; tropical regions); LEUCAS (tropical regions; Africa, Asia); LOPHANTHUS (central Asia; China); LYCOPUS (northern temperate regions); MARRUBIUM (Europe, North Africa, temperate Asia); MARSYPIANTHES (warm America); MELISSA (Europe, western Asia); MELITTIS (Europe); MENTHA (Old World); MERIANDRA (Himalaya; Abyssinia); MICROMERIA (cosmopolitan); MONARDA (North America); MONARDELLA

(Western North America); MOSCHOSMA (palaeotropical regions); MOSLA (Himalaya to Japan); NEPETA (northern hemisphere); OCIMUM (tropical and warm temperate regions); ORIGANUM (Europe; Mediterranean region); ORTHOSIPHON (Indo-Malayan region; tropical Africa); OTOSTEGIA (western Asia; Abyssinia); PELTODON (Brazil, Paraguay); PERILLA (India to Japan); PEROWSKIA (western Asia); PHLOMIS (northern palaeotemperate regions); PHYSOSTEGIA (North America); PLATYSTOMA (tropical Asia; Africa); PLECTRANTHUS (palaeotropical regions; eastern Asia); POGOGYNE (California); POGOSTEMON (Indo-Malayan region); PYCNANTHEMUM (North America); ROSMARINUS (Mediterranean region); ROYLEA (Himalaya); SALVIA (tropical and temperate regions); SATUREIA (warm regions); SCUTELLARIA (cosmopolitan, except South Africa); SOLENOSTEMON (western Africa); SPHACELE (warm America; Hawaiian Isles); STACHYS (cosmopolitan, except Australia); SYNCOLOSTEMON (southern Africa); TETRADENIA (tropical Asia; Australia); TEUCRIUM (cosmopolitan); THYMBRA (south-eastern Europe; western Asia); THYMUS (Old World); TRICHOSTEMA (North America); ZATARIA (Persia, Afghanistan); ZIZIPHORA (Mediterranean region; central Asia).

The medicinal and poisonous Labiates of India are included in the following 49 genera:—ACROCEPHALUS, AJUGA, ANISOCHILUS, ANISOMELES, BRUNELLA, CALAMINTHA, COLEBROOKEA, COLEUS, DRACOCEPHALUM, DYSOPHYLLA, ELSHOLTZIA, EREMOSTACHYS, GALEOPSIS, GENIOSPORUM, GOMPHOSTEMMA, HYMENOCRATER, HYPTIS, HYSSOPUS, LALLEMANTIA, LAMIUM, LAVANDULA, LEONOTIS, LEONURUS, LEUCAS, LYCOPUS, MARRUBIUM, MELISSA, MENTHA, MERIANDRA, MICROMERIA, MOSCHOSMA, NEPETA, OCIMUM, ORIGANUM, ORTHOSIPHON, OTOSTEGIA, PERILLA, PEROWSKIA, PLATYSTOMA, POGOSTEMON, ROYLEA, SALVIA, SATUREIA, SCUTELLARIA, STACHYS, TEUCRIUM, THYMUS, ZATARIA, ZIZIPHORA.

I. Perfect stamens 4, rarely 2, declinate. Anther-cells confluent. Ovary 4-partite. Nutlets dry. Basal scar small.

A. Lower lip of corolla 1-lobed; stamens usually exserted; basal scar of nutlets not oblique.

1. Lower lip of corolla flat or nearly so.

a. Calyx deflexed in fruit, upper lobe recurved, margin decurrent on the tube.

i. Corolla-tube not exceeding the calyx, stigma 2-fid ... ... OCIMUM.

ii. Corolla-tube exceeding the calyx, stigma entire ... ... ORTHOSIPHON.

b. Calyx sub-erect or declinate in fruit, upper lobe not recurved, margins not decurrent.

i. Flowers in globose heads or in simple spikes or racemes.

α. Calyx narrowly tubular in fruit.

* Calyx suberect, upper lip 1-lobed, lower lip entire or 4-toothed ... ACROCEPHALUS.

** Calyx usually declinate, upper lip 1-lobed, with the lateral and lower teeth free, or the lateral teeth united with the upper lobe ... ... GENIOSPORUM.

β. Calyx widely campanulate in fruit ... PLATYSTOMA.

ii. Flowers in paniculate racemes ... ... MOSCHOSMA.

2. Lower lip of corolla conspicuously concave, or boat-shaped.
   a. Corolla distinctly 2-lipped, lower lip longer than the upper.
      i. Upper lip of calyx rounded, deflexed; or the calyx subequally 5-toothed ... COLEUS.
      ii. Upper lip of calyx beaked or truncate, curved downwards to close the mouth, or the calyx 1-lipped, the upper lip absent ... ANISOCHILUS.
   b. Corolla 5-lobed, the lowest lobe shorter or equalling the other lobes ... ... HYPTIS.

B. Lower lip of corolla 3-fid; stamens included; basal scar of nutlets oblique ... ... LAVANDULA.

II. Perfect stamens 4 with the upper pair longest or 2 straight diverging or ascending. Anthers 1- or 2-celled.

A. Stamens 2; anterior perfect, anther-cells parallel ... LYCOPUS.

B. Stamens 4.

1. Stamens subequal not didynamous.
   a. Anthers 1-celled.
      i. Calyx 5-toothed, teeth neither feathery nor longer than the tube.
         α. Corolla sub-2-lipped, lower lip longer ... POGOSTEMON.
         β. Corolla equally 4-fid ... ... DYSOPHYLLA.
      ii. Calyx 5-partite, segments feathery, longer than the tube ... ... COLEBROOKEA.
   b. Anthers 2-celled.
      i. Fruiting calyx 2-lipped; corolla 5-lobed ... PERILLA.
      ii. Fruiting calyx 5-toothed; corolla 4-lobed ... MENTHA.
2. Stamens didynamous.
   a. Anther-cells at length confluent, (2-celled when young ... ... ELSHOLTZIA.
   b. Anther-cells never confluent.
      i. Calyx 5-nerved ... ... ZATARIA.
      ii. Calyx 15-nerved
         α. Stamens exserted ... ... HYSSOPUS.
         β Stamens ascending under the hood ... HYMENOCRATER.
      iii. Calyx 10-13-nerved
         α. Corolla subequally 4-lobed, or obscurely 2-lipped; calyx-throat villous, mouth closed by the villi.
            * Whirls many-flowered, capitate; bracts conspicuous forming an involucre ... ... ORIGANUM.
            ** Whorls few-flowered, not capitate; bracts minute, not forming an involucre ... ... THYMUS.
         β. Corolla distinctly 2-lipped, calyx-throat glabrous or hairy, mouth not closed.
            * Corolla-tube straight.
               ¶ Calyx sub-equally 5-toothed, or obscurely 2-lipped; corolla-tube not exceeding the calyx.
                  † Calyx usually 10-nerved (leaves linear-oblong in Indian species) ... ... SATUREIA.
                  †† Calyx usually 13-nerved (leaves broadly ovate in Indian species) ... ... MICROMERIA.
               ¶¶ Calyx distinctly 2-lipped, corolla-tube exceeding the calyx ... CALAMINTHA.
            ** Corolla-tube recurved and ascending MELISSA.

III. Perfect stamens 2, ascending, parallel. Anther-cells linear, solitary or separated by a filiform connective.
- A. Anther-cells equal, contiguous, pendulous from a small connective ... ... PEROWSKIA.
- B. Anther-cells equal, distant, pendulous from a long connective ... ... MERIANDRA.
- C. Anther-cells very unequal or solitary on a long connective ... ... SALVIA.
- D. Anthers connate at the margin ... ... ZIZIPHORA.

IV. Perfect stamens 4 with the upper pair longest, rarely 2, ascending or diverging. Anthers 2-celled, cells at length diverging. Ovary 4-partite.
- A. Calyx tubular, 5-toothed ... ... NEPETA.
- B. Calyx 2-lipped, upper lip much the larger ... DRACOCEPHALUM
- C. Calyx 2-lipped, lateral lobes of upper lip on the face of the midlobe ... ... LALLEMANTIA.

V. Perfect stamens 4, ascending, lower pair longest. Calyx 5-10-nerved. Upper lip of corolla erect, lower spreading, trif.
- A. Calyx deeply 2-lipped; mouth of fruiting calyx closed by the lips.
  - 1. Lips of calyx entire, upper lip with a broad-plate ... ... SCUTELLARIA.
  - 2. Upper lip of calyx 3-toothed, without any plate, lower lip 2-toothed ... ... BRUNELLA.
- B. Calyx tubular or campanulate, 5-10-toothed, or obscurely 2-lipped, mouth not closed.
  - 1. Upper lip of corolla flat, not hooded.
    - a. Stamens included in the corolla-tube. ... MARRUBIUM.
    - b. Stamens exserted from the corolla-tube ... ANISOMELES.
  - 2. Upper lip of corolla hooded.
    - a. Calyx with a very widely expanded limb, with sinuate margin ... ... OTOSTEGIA.
    - b. Calyx limb not expanded, 5-lobed, or 5-10-toothed.
      - i. Anther-cells hairy.
        - α. Anther-cells transverse; nutlets compressed ... ... GALEOPSIS.
        - β. Anther-cells not transverse; nutlets triquetrous ... ... LAMIUM.
      - ii. Anther-cells glabrous.
        - α. Calyx-teeth much shorter than the tube.
          - *Calyx 8-10-toothed.
            - ¶ Upper lip of corolla shorter than the lower ... ... LEUCAS.
            - ¶¶ Upper lip of corolla longer than the lower ... ... LEONOTIS.
          - ** Calyx 5-toothed, or lobed.
            - ¶ Upper filaments not appendiculate at the base.
              - † Anther-cells not transverse, (leaves not sected) ... STACHYS.
              - †† Anther-cells transverse, (leaves much sected) ... ... LEONURUS.
            - ¶¶ Upper filaments appendiculate at the base ... ... EREMOSTACHYS.
        - β. Calyx- teeth or - lobes as long as or longer than the tube ... ... ROYLEA.

V. Stamens straight or ascending. Nutlets with a small basal scar or areola, rugose with a thick and slightly fleshy pericarp ... ... GOMPHOSTEMMA.

VI. Stamens 4, ascending; calyx 10-nerved. Ovary 4-lobed. Nutlets with a large, oblique or lateral areola.

A. Corolla 1-lipped, upper lip absent, lower 5-lobed ... TEUCRIUM.

B. Corolla 2-lipped, upper entire or 2-fid, lower 3-lobed ... ... AJUGA[1]

ACROCEPHALUS.

The genus numbers 40 species, spreading from the Malay Archipelago to Africa.

A. lilacinus Oliv. is a Gold Coast remedy for headache.

Acrocephalus indicus O. Kunz. is found all over India and ascends to 5,000 ft. in the Himalayas.

The plant is used as an expectorant in Sind.

Sindi: Ustukudus—.

AJUGA.

The genus consists of 30 palaeotemperate species.

A. Iva Schreb. is used medicinally in Europe; *A. Chamaepitys* Schreb. in Europe and the M'Zab; *A. reptans* Linn. in Europe and North America; *A. ophrydis* Burch. in South Africa.

Ajuga bracteosa Wall. is a small herb inhabiting the North-West Frontier Province, Kashmir, Punjab, Kumaon, and Nepal. It extends to Afghanistan, Tibet, China, Japan, and Abyssinia.

In the Punjab the leaves are given in the treatment of fevers as a substitute for cinchona. The plant is considered a bitter astringent and an aromatic tonic, specially useful in ague.

On the Salt Range it is used to kill lice, and is regarded as depurative.

Jhelum: Kauriboti—; *Kumaon*: Ratpatha—; *Sutlej*: Karku, Nilkantihi—; *Trans-Indus*: Khurbanri—.

ANISOCHILUS.

The genus consists of 20 species, inhabiting the tropical areas of Asia and Africa.

Anisochilus carnosus Wall. is an erect annual herb found all over the country, from Western Himalaya to Burma and South India, and Ceylon.

The fresh juice of the leaves mixed with sugar-candy is given by the Tamil doctors in cynanche; and mixed with sugar and gingelly-oil, is used as a cooling liniment for the head.

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[1] Dr. S. K. Mukerjee.—A Revision of the Labiatae of the Indian Empire. *Records Bot. Survey of India;* vol. xiv, no. 1; 1940.

The plant is a mild stimulant, expectorant, particularly useful in the cough of childhood. The juice of the leaves mixed with sugar and human milk is in Mysore a popular domestic remedy for coughs in children.

The juice of the leaves is commonly used in catarrh.

The plant yields a volatile oil which is credited with stimulant, diaphoretic, and expectorant properties.

Bombay: Choraonva, Kapurli—; *Canarese*: Doddapatri—; *Deccan*: Ajvan, Panjiri—; *Hindi*: Panjiri—; *Gujerati*: Ajama, Ajmamupatru, Ubhoratavelio—; *Malayalam*: Chomara, Kattukurkka, Kurkka, Patukurkka—; *Marathi*: Choraonva, Kapurli—; *Pondicherry*: Lavande—; *Sinhalese*: Galkapprawalliya—; *Tamil*: Karppuravalli—; *Telugu*: Kurpuravalli, Omamu-aku, Rogachettu—.

ANISOMELES.

The genus consists of 6 Indo-Malayan species, spreading to Australia.

A. indica O. Ktze is used medicinally in Annam, the Philippine Islands, and La Reunion; *A. malabarica* R. Br. also is used in La Reunion.

Leaves broadly ovate. Nutlets black ... ... *A. indica*.
Leaves oblong-lanceolate. Nutlets pale brown ... *A. malabarica*.

1. **Anisomeles indica** O. Ktze is found throughout India, ascending to 6,000 feet in the Himalayas. It is distributed to Ceylon, the Malay Peninsula and Archipelago, the Philippine Islands, and China.

The plant has carminative, astringent, and tonic properties. It yields an essential oil which, in Ceylon, is used in uterine affections.

Bombay: Gopali—; *Cantonese*: Ts'in ts'o—; *Chinese*: Ch'ien Ts'ao—; *Malaya*: Hee chin choo—; *Sinhalese*: Yak-wanassa—; *Tagalog*: Talingharap—.

2. **Anisomeles malabarica** R. Br. is found in the Deccan peninsula, and is a well-known plant in Southern India, whence it spreads to Ceylon, Malaya, and Mauritius.

In Southern India, few plants are held in higher esteem, or are more frequently employed in native practice, than this. An infusion of the aromatic bitter leaves is in common use in affections of the stomach and bowels, catarrhal affections and intermittent fevers.

In addition to its internal use in the cure of fevers, patients are made to inhale the vapour of a hot infusion so as to induce copious diaphoresis. An infusion of the leaves is given to children in colic, dyspepsia and fever arising from teething. A decoction of the plant, or the essential oil distilled from the leaves, is used externally in rheumatism.

In La Reunion the plant is considered sudorific and antipyretic. It is given for rheumatism.

In Mauritius is credited with antispasmodic and emmenagogue properties. It is given for flatulence, and in hysteria.

An infusion of the leaves of this plant is given on the west coast to children in colic, dyspepsia and fever arising from teething.

The infusion acts as a diaphoretic. An infusion (1 in 10) was tried in fever accompanying teething and was found useful (Koman).

Bombay : Chodhara— ; *Canarese* : Karitumbe— ; *Deccan* : Mogbirekapatta— ; *English* : Malabar Catmint— ; *Gujerat* : Gholochodharo, Makhmalichodharo— ; *Malayalam* : Karintumpa, Pemarutti, Peruntumpa— ; *Marathi* : Chodhara, Pandrachodhara, Sundara, Sundraphal— ; *Mauritius* : Menthe musquée des Malabars, Boutankoushum, Pémayretti— ; *Sanskrit* : Oshthaphala, Vaikuntha— ; *Tamil* : Irattaippeymarutti, Peymarutti, Peyverutti, Sadumbai— ; *Telugu* : Chinnaranabheri, Magabira, Mogabheri—.

Brunella.

This genus includes 5 more or less cosmopolitan species.

B. vulgaris Linn. is used medicinally in Europe, China, and Malaya.

Brunella vulgaris Linn. occurs in the temperate Himalaya from Kashmir to Bhutan from 4,000 to 11,000 feet, in the Khasia Hills at 4,000-6,000 feet, and on the hills of South India: Nilgiris, Pulneys, and Travancore mountains. It inhabits most of the temperate regions of the Northern Hemisphere, and is to be found in Australia.

The herb is aromatic and carminative; reputed useful in the treatment of haemorrhages and diarrhoea. It is esteemed by herbalists for relaxed throats.

'The decoction of Prunell', says Gerarde, 'made with wine and water, doth join together and make whole and sound all wounds, both inward and outward . . .' 'There is not a better Wound herbe in the world . . . ' The whole herb has astringent, styptic, and tonic properties.

Self-Heal is still in use in modern herbal treatment as a useful astringent for inward and outward use.

An infusion of the herb, made from 1 oz. to a pint of boiling water, and taken in doses of a wineglassful, is considered a general strengthener. Sweetened with honey, it is good for a sore and relaxed throat or ulcerated mouth, for both of which purposes it also makes a good gargle. For internal bleeding and for piles, the infusion is also used as an injection. It is a household remedy in Germany.

The Swiss peasants use the plant as a vulnerary.

Regarded by the Punjab Himalayan hill tribes as expectorant and antispasmodic (Stewart). The green leaves smeared with castor oil and warmed over the fire are applied externally to the anus in cases of painful piles.

The plant is used for fevers and coughs in China and Malaya, and is considered there anti-rheumatic, alterative, and tonic.

The Flambeau Ojibwe Indians of North America use the root to make a tea to drink before going hunting; it is supposed to sharpen their powers of observation. They also use the root mixed with others for a female remedy.

The whites of Wisconsin use the root as a pungent and bitter tonic and antispasmodic; they credit it with vermifuge properties,

and regard it as slightly diuretic. The root has also been used for obstructions of the liver, cramps and fits.

Arabic: Anas-ul-rawah—; *Chinese*: Hsia K'u Ts'ao—; *English*: All-heal, Brown-wort, Brunel, Brunella, Bumble-bees, Carpenter-grass, Carpenter's Herb, Fly Flowers, Heart of the Earth, Herb Carpenter, Hercules' All-heal, Hercules' Wound-wort, Hook-heal, London Bottles, Pick Pocket, Pimpernel, Prince's Feather, Proud Carpenter, Prunella, Self-heal, Sickle-wort, Slough-heal—; *French*: Bonnerette, Bonnette, Brunelle, Brunellier, Brunette, Charbonnière, Herbe au charpentier, Pâquerette, Petite consoude, Petite consyre, Prunelle—; *German*: Braunelle, Braunheil—; *Hindi*: Dharu—; *Italian*: Brunella—; *Malaya*: Lo han tsao, Look ham chow—; *North America*: Blue Curls, Carpenter Weed, Heal-all, Heart of the Earth, Self-heal—; *Ojibwe*: Basi' bûgûk—; *Persian*: Ustekhadus—; *Punjab*: Austakhadus—; *Roumanian*: Busuioc de camp, Busuioc marunt—; *Sind*: Ustukhudus—; *Spanish*: Brunela, Consuelda menor—; *Urdu*: Ustekhadus—; *Yorkshire*: Black Man—.

Calamintha.

The genus numbers 60 species, scattered over the northern temperate regions and the mountains of the Tropics.

C. Acinos DC., *C. alpina* Lam., *C. Clinopodium* Benth., *C. grandiflora* Moench, *C. Nepeta* Savi., *C. officinalis* Moench are used medicinally in Europe.

The flowered plant of *C. officinalis* Moench is official in France.

Calamintha Clinopodium Benth. is found in the western temperate Himalaya, from Kashmir to Kumaon, at 4,000-12,000 feet. It is distributed to northern and western Asia, Europe, North Africa, and Canada.

The plant is cephalic, astringent, carminative, and tonic to the heart.

Arabic: Asaba-el-fatiyat—; *Catalan*: Alfábrega boscana—; *French*: Clinopode—; *Spanish*: Albahaca silvestre major, Angelotes, Clinopodio, Pie de cama, Perilla de cama—.

Colebrookea.

A Himalayan genus, comprising only one species.

Colebrookea oppositifolia Sm. is one of the commonest and most abundant plants in the lower Himalaya. It occurs all over India, in the hilly parts, from Peshawar to Burma, and Simla to Travancore.

A preparation from the root is used by the Santals in epilepsy.

The leaves are applied to wounds and bruises.

The down on the stem and leaves is used by the Paharias of Sikkim to extract worms from bad sores on their legs.

Bombay: Bahmani, Bhamini, Dasai, Dasari, Dussarica—; *Canarese*: Tuggigidda—; *Dehra-Dun*: Binde, Bindu—; *Garhwal*: Binda, Bindu—; *Hindi*: Binda, Bindu, Pansra—; *Jaunsar*: Bambher, Lulri—; *Khond*: Darigopi, Merata—; *Kumaon*: Binda, Bindu, Dulshat—; *Matheran*: Bhaman—; *Melghat*: Chotabhandara—; *Nepal*: Dosul—; *Punjab*: Barmera, Basuti, Briali, Dashane, Duss, Phisbekkar, Sampru, Shakardana, Suali—; *Ramnagar*: Bhuriruderi—; *Saharanpur*: Bintalakri, Kalabansa—; *Santali*: Barsakapor, Bhainsa—; *Saora*: Jolidi—; *Trans-Indus*: Shakardana—; *Uriya*: Bosiki, Darigopi—.

Coleus.

This genus consists of 150 palaeotropical species.

C. Amboinicus Lour. is used medicinally in Cambodia, the Malay Archipelago, and the Philippine Islands; *C. atropurpureus* Benth. in the Philippine Islands; *C. Bojeri* Benth. in Madagascar; *C. dysentericus* Baker in Nyassaland, Nigeria, and Madagascar; *C. floribundus* Baker in Ubanghi-Shari.

Coleus Amboinicus Lour., a native of the Moluccas, is cultivated in gardens throughout India, and Ceylon. It occurs wild in Rajputana.

The leaves are said to have a specific action on the bladder and to be useful in urinary diseases, vaginal discharges, etc. The juice mixed with sugar is given in cases of colic in children, and acts as a powerful aromatic carminative.

In spite of its intoxicating properties the people of Bengal employ it in colic and dyspepsia.

The expressed juice of the leaves is considered an anodyne and astringent, and applied over and around the eyelids, in cases of conjunctivitis.

In Ceylon a decoction of the leaves is given for asthma, chronic coughs, etc.

In Cochin-China the juice of the leaves is considered carminative and is given to children suffering from wind colic. The decoction is given for asthma, chronic bronchitis, epilepsy, and convulsions.

The leaves are official in Holland.

Bengal: Paterchur—; *Bombay*: Owa, Pathorchur, Pathurchur—; *Cambodia*: Chi trasak damrey—; *Hindi*: Pathorchur—; *Malay Archipelago*: Daoen Koetjing, Djinten—; *Marathi*: Panacha ova, Patharchur—; *Philippines*: Oregano—; *Sanskrit*: Pashanabhedi—; *Sinhalese*: Kapprawalliya—; *Tagalog*: Suganda—.

Dracocephalum.

The genus consists of 40 species, inhabiting the temperate regions of the Northern Hemisphere.

Dracocephalum Moldavica Linn. is found in the western temperate Himalaya and Kashmir, at altitudes of 7,000 to 8,000 feet. It extends to northern Asia and Europe.

In Patna the seeds are used ground up in fevers, and as demulcent.

The seeds afford an opaque mucilage when soaked in water. The drug is esteemed in Persia as a carminative and tonic.

In Europe the plant is considered tonic, astringent, and vulnerary.

Arabic: Asaba-el-fatiyat, Baklat-el-utrujuya—; *Hindustani*: Tukhm- ferunjmishk—; *Persian*: Badrendj-bouyih, Badrendj-buya, Karanfalihostani—; *Spanish*: Melisa de Moldavia, Torongil de Turquia—; *Tabriz*: Badirash-bu—; *Teheran*: Badranj-buya—.

Dysophylla.

The genus consists of 20 species, inhabiting eastern Asia and Australia.

Dysophylla auricularia Blume is found in Sikkim, eastern Bengal, Assam, Burma, Singbhum, Poona, and South India. It is distributed to Ceylon, the Malay peninsula and islands, the Philippine Islands, and China.

The herb is a Malayan remedy for colic. The leaves are powdered with lime and rubbed on the abdomen.

Malay: Ekor kuching, Poko awi tana—.

Elsholtzia.

The genus consists of 30 species distributed over Asia, Europe, and Abyssinia.

Elsholtzia cristata Willd. is to be found from Kashmir to Mishmi at 1,200-9,000 feet. It has been of late introduced in the Nilgiris. It spreads to Tibet, China, Japan, northern Asia, and Europe.

In China and Cochin-China the plant is used as a medicine, a pot herb, and a condiment. In Annam the flowering tops are given as a diuretic. In Japan the leaves are used for tea. In a general way, like other Labiates, the drug is regarded by the Chinese as carminative, stomachic, and astringent.

Cantonese: Heung ue—; *Chinese*: Hsiang Ju—; *Malaya*: Heong yee—.

Eremostachys.

The genus numbers 40 species, natives of Central and Western Asia.

Bracts and bracteoles spine-tipped, equalling calyx; bracteoles connate below in groups of 3 ... ... *E. acanthocalyx.*

Bracts and bracteoles not spiny, much shorter than calyx, all free ... ... *E. Vicaryi.*

1. **Eremostachys acanthocalyx** Boiss. is found in West Punjab and Baluchistan, whence it extends to Baluchistan.

The Baluchis consider the plant poisonous.

Kirani: Bishkhaf—.

2. **Eremostachys Vicaryi** Benth. occurs in Western Punjab and is common on the Salt Range, ascending to 2,500 feet. It is also found at Peshawar and in Baluchistan.

In the Punjab the seeds are given as a cooling medicine.

The plant is said to be used in the Eusufzai near Peshawar for poisoning fish.

Kila Saifulla: Khurzbin—; *Pab Hills*: Bischkhaf—; *Punjab*: Gurgunna, Khalatra, Rewandchini—.

Galeopsis.

A genus of 7 palaeotemperate species, inhabiting the Northern Hemisphere.

G. ochroleuca Lam. is official in the Pharmacopoeia of Austria.

Galeopsis Tetrahit Linn. occurs in Sikkim and Kashmir. It is distributed over Tibet, North and West Asia, Europe; and has been introduced into North America.

The plant is well spoken of as an expectorant, and in phthisical complaints. An infusion of the whole plant is used in the treatment of pulmonary troubles. It has also been employed as an anti-spasmodic resolvent, and a detergent.

English: Bastard Hemp, Bee-nettle, Blind Nettle, Dai-nettle, Day-nettle, Dea-Netle, De-Nettles, Deye-Nettle, Dog Nettle, Donnine-thell, Female Hems, Glidewort, Hemp Nettle, Holyrope, Nettle Hemp, Stinging Nettle, Sting Nettle—; *Forest Potawatomi*: Mena' kwûskûk—; *North America*: Common Hemp Nettle—.

GENIOSPORUM.

The genus includes 15 species scattered over Africa, Madagascar, and the Indo-Malayan region.

Geniosporum prostratum Benth. is found in sandy ground from the Konkan southwards, especially near the sea, and in the warmer parts of Ceylon.

In Pondicherry this plant is credited with febrifugal properties.

Pondicherry: Nazelnagai—.

GOMPHOSTEMMA.

A genus of 25 Indo-Malayan species spreading to China.

Gomphostemma crinitum Wall. occurs in Assam, Burma, and the Malay Peninsula.

var. *Griffithii* Prain, which is found in Tenasserim and Malaya, is administered in the form of decoction after confinements.

Malay: Munjulong bukit—.

HYMENOCRATER.

The genus consists of 9 species, natives of Western Asia.

Hymenocrater sessilifolius Benth. occurs in Baluchistan and Afghanistan.

In Baluchistan the leaves are left overnight soaking in water, and the infusion is given as a morning drink to children.

Baluchistan: Sursánda—.

HYPTIS.

This large genus numbers 300 species, natives of warm America.

The following species are used medicinally in Madagascar and West Tropical Africa.—*H. pectinata* Poit., *H. spicigera* Lam.—; in Guiana—*H. verticillata* Jacq.—; in Brazil—*H. canescens* Benth., *H. fasciculata* Benth., H. *fruticosa* Salzm., *H. graveolens* Salzm., *H. pectinata* Poit., *H. spicata* Poit., *H. suaveolens* Poit., *H. umbrosa* Salzm—.

Flowers not in globose heads.
- Calyx 3 mm. long in fruit ... ... *H. pectinata*
- Calyx 8-10 mm. long in fruit ... ... *H. suaveolens*

1. **Hyptis pectinata** Poit. is found in Bengal, Assam, and the Madras Presidency. It is distributed over tropical Africa and Asia.

In Ashanti and South Nigeria the plant is a medicine for young children, and used in connection with childbirth. Poultices of the leaves are applied for chest complaints.

In North Nigeria the leaf is used for fever. It is boiled for horses to inhale the vapour for diseases accompanied by mucous catarrh.

In Madagascar the plant is considered aromatic, tonic, anthelmintic, antispasmodic, emmenagogue, and odontalgic. It is mostly used to expel worms in children. A decoction or infusion of the flower heads is given in fever, and for chest troubles.

Adangme: Kadokeng—; *Angola*: Quibumbo, Quimbumba, Quinbumbo, Quinbungu—; *Ashanti*: Piaa—; *Awuna*: Awusa-kadi—; *Betsileo*: Afolava—; *Dagomba*: Baeba—; *Ga*: Suruwie—; *Hausa*: Kimba-kimba, Kimbar awaki, Kimbar dawaki—; *Hova*: Rombatsahona, Sangasanganandevolahy—; *Sakalave*: Sangasanganimarina—; *Twi*: Opea, Peaba—; *Yoruba*: Jogbo—.

2. **Hyptis suaveolens** Poit. occurs in the Deccan, in Chota Nagpur, Bengal, Assam, Burma, and the Andaman and Nicobar islands. It is distributed to the Malay Archipelago, the Philippine Islands, Formosa, Indo-China, Siam, and tropical Africa.

In Orissa the plant is pounded and applied to parasitical cutaneous diseases.

In West Tropical Africa an infusion of dried leaves is taken for fever. The plant is tied round the head for headache or applied to cure boils, and the juice of the pressed leaves along with lime juice is drunk for colic and stomach-ache.

In Brazil an infusion is used as a carminative and as a sudorific in catarrhal conditions.

Colombia: Botón morado, Chavito, Mastrantillo, Mastranto de perro, Mastranto de sabana, Yerba de las muelas, Yerba de la reuma—; *Malay*: Malbar hutan, Sapulut, Selasik hutan—; *Mal Paharia*: Purudo—; *Mandingo*: Fure-jambo—; *Mexico*: Chan—; *Panama*: Purgaperro, Salvia—; *Santali*: Gangatulsi—; *Tagalog*: Pansipansiyan, Soobcabayo—; *Timne*: Bupi-bupi—; *Uriya*: Gangatulsi, Purodo—; *Venezuela*: Mastranto—; *Visayan*: Locoloco—; *Yoruba*: Jogbo—.

Hyssopus.

Hyssopus officinalis Linn., the sole representative of the genus, is found in the Western Himalaya, from Kashmir to Kumaon, at 8,000-11,000 feet. It spreads to Western Asia, and grows wild in middle and southern Europe.

Hyssop is classed by the Arabians amongst their anthelmintics, stimulants, and deobstruents. In Europe it has long been known as a tonic and stimulant, and was at one time in great repute as a remedy for nervous diseases. *Pliny* also thought it useful in chest affections, and *Celsus* regarded it as an anthelmintic.

Hyssop tea is a grateful drink, well adapted to improve the tone of a feeble stomach, being brewed with the green tops of the herb. The same parts of the plant are sometimes boiled in

soup to be given for asthma. To make Hyssop tea, one drachm of the dried herb should be infused in a pint of boiling water, and allowed to become cool. Then a wineglassful is to be given as a dose two or three times a day. It is of use in the ailments of women.

A distilled water of Hyssop is deemed a good pectoral medicine.

The essential oil, in doses of one to two drops, promotes expectoration in bronchial catarrh and asthma.

The green herb, bruised and applied, will heal cuts promptly. If it be steeped in boiling water and applied hot to the part, it will quickly remove the blackness consequent upon a bruise or blow, especially in the case of 'black' or blood-shot eyes. In America an infusion of the leaves is used externally for the relief of muscular rheumatism, as also for bruises and discoloured contusions.

The juice of the leaves made into a syrup with sugar and honey is used as a vermifuge for roundworms.

A decoction of the flowers of this plant from Persia was given in cases of asthma and chronic bronchitis and found to be a useful remedy in those complaints (Koman).

The flower-tops are official in France, Portugal, and Sweden; the leaves too are official in France.

Arabic : Zufah-e-Yabis, Zufah-ul-retih—; *Catalan* : Hisop—; *Danish* : Isop—; *Dutch* : Hysop—; *English* : Hyssop—; *French* : Herbe sacrée, Hysope—; *German* : Apothekerhysop, Eiserich, Gartenrispe, Hyssop, Isipo, Isop, Ispern, Issel, Josephskraut, Klosteruesopp, Lufftskraut, Ysop—; *Greek* : Hysopos—; *Hebrew* : Esof—; *Hindi* : Zufah yabis—; *Italian* : Isopo, Issopo—; *Languedoc* : Mariarmo—; *Persian* : Zufah-e-khuskka, Zufah-e-tar, Zufah-e-yabis—; *Polish* : Isopek—; *Portuguese* : Hissopo—; *Roumanian* : Cimbru cel brun, Isop—; *Russian* : Issop—; *Spanish* : Hisopo—; *Swedish* : Isop—; *Urdu* : Zufah yabis—.

LALLEMANTIA.

The genus consists of 4 species, inhabiting Western Asia.

Lallemantia Royleana Benth. occurs in the North West Province, the Punjab plains and hills, and Baluchistan; extending to Afghanistan, Persia, and Turkestan.

The plant is largely grown on account of its mucilaginous seeds, which are considered cooling and sedative, and are extensively employed in the preparation of a mucilaginous beverage. In Persia they are used for cough, and as a stimulant and aphrodisiac.

In the Punjab the seeds are used as cooling and sedative remedies.

Bombay : Tukhmibalangu—; *Hamadan* : Balingan—; *Harboi Hills* : Fuchkin, Yakhtali—; *Hindi* : Ghareikashmalu, Tukhmbalangu, Tukhmlealanga—; *Kashmir* : Tukhmibalunga—; *Punjab* : Ghareikashmalu, Tukhmbalangu, Tukhmmalanga, Tukmalanga—; *Persian* : Tukhmibalangu—; *Urdu* : Balanga—.

LAMIUM.

The genus includes 40 species distributed over Europe, North Africa, and temperate Asia.

Lamium album Linn. occurs in Kashmir, the Punjab, Kumaon, and Hazara. It is scattered over northern and western Asia, North Africa, and Europe.

The root is used medicinally in China. In Spain it is considered astringent and is used as a resolvent and vulnerary.

Catalan: Ortiga morta—; *Chinese*: Hsu Tuan—; *English*: Archangel, Bee Nettle, Blind Nettle, Day Nettle, Dead Nettle, Deaf Nettle, Dee Nettle, Dumb Nettle, Dummy Nettle, Dunny Nettle, Nettle, Snake Flower, Stingy Nettle, Suck-bottle, Suckie Sue, White Archangel, White Deadnettle, White Nettle—; *French*: Archangélique, Galéopsis, Lamier blanc, Lamion, Marachemin, Ortie blanche, Ortie morte, Pied de poule, Suçots blancs—; *German*: Bienenhuetel, Biemensang, Dahnnessel, Dangel, Daudelblume, Eddernessel, Eisblume, Gageneier. Heddernessel, Honigsugel, Huehnernessel, Hundnessel, Loeffelblume, Sengenessel, Suegede, Taubnessel, Taunessel, Urinblume, Wasserblume, Weisse Betonie, Weisser Ganzert, Weisser Kuckuck, Weisse Suegete, Wurmnessel—; *Italian*: Lamio bianco—; *Russian*: Sadovui dyagil—; *Spanish*: Ortiga blanca, Ortiga muerta, Ortiga muerta blanca—.

LAVANDULA.

The genus consists of 20 species spreading from the Mediterranean to India.

L. dentata Linn., *L. Spica* DC., *L. Stoechas* Linn., *L. vera* DC. are used medicinally in Europe.

Lavandula bipinnata O. Ktze. occurs in Chota Nagpur, Mount Abu, Konkan, Jubbulpore, Khandesh, and the Deccan.

It is reported that the villagers and shepherds of the Barda Hills in Kathiawar use the plant as a medicine.

The plant is supposed to act as an antidote against snake poison. The roots are rubbed with water and the solution or the paste is applied over the sting or the bite of poisonous animals. The powdered leaves are given for inhalation to the person who has been bitten by a serpent in order to prevent him from falling into sleep.

Gujerati: Aasmanigalgoto, Sarpnocharo—.

LEONOTIS.

The genus consists of 15 tropical and South African species.

L. dysophylla Benth., *L. Leonitis* R. Br., *L. Leonurus* R. Br., *L. microphylla* Skan., *L. mollis* Benth. are used medicinally in South Africa; *L. africana* Brig. is used in Angola and Northern Nigeria; *L. nepetaefolia* R. Br. in Northern Nigeria, Madagascar, and Brazil.

Leonotis nepetaefolia R. Br. is found, either cultivated or naturalized, in the Punjab and all the hotter provinces of northern and southern India, whence it spreads to Ceylon. It is distributed to tropical Asia, Africa, and America.

In Chota Nagpur the ashes of the flower-heads are applied to burns and scalds; in Bombay they are mixed with curds and applied to ringworm and other itchy diseases of the skin.

The plant is used medicinally by the Mundas of Chota Nagpur. The whorl, in flower or in seed, is pounded and fried in Koronj

oil; this is rubbed on itch, also on head sores of small children. When a mother's breasts swell and milk does not pass through the nipples, the crushed root is rubbed on the breast (*Encyclopoedia Mundarica*).

In Loanda a decoction of the plant is used in diseases of the abdomen.

In Northern Nigeria the leaf pounded with natron is applied locally for swellings and ulcers supposed to be of syphilitic origin; the fresh leaves are applied for headache. A decoction is used to steam the head to relieve catarrh, fever, etc., and is taken also internally as a tonic and febrifuge, and for gastro-intestinal troubles. The plant is put amongst stored corn to keep away vermin.

In Madagascar the plant is considered emmenagogue, febrifuge, depurative, narcotic, bitter, and laxative; used in skin diseases, amenorrhoea, and fever.

In Porto Rico a decoction of the leaves is used as a tonic; the juice is also expressed and taken with limejuice and rum as a febrifuge.

The leaves are used in Brazil in the treatment of rheumatic affections.

Bengal: Hejurchei—; *Bombay*: Matijer, Matisul—; *Brazil*: Cordao do frade—; *Ceylon*: Kasitumpai—; *Efik*: Ubiom—; *Fulani*: Hore gujjo—; *Gujerati*: Matijer, Matisul—; *Hausa*: Chika saura, Jam'barawo, Kam mutum, Tutar'yan sarki—; *Hindi*: Baraguma, Hejurchei—; *Krobo*: Nyeddo—; *Lagos*: Iku ekun—; *Loanda*: Maluvo, Maluvo-iamconco, Maluvo-iamgilla, Maluvo-m'angilla—; *Mano*: Seto a yi—; *Marathi*: Dipmal, Ekri—; *Mauritius*: Dacca, Léonure—; *Mundari*: Agiajanum, Gharia, Hatuseng-gelsui, Senggelsui—; *Porto Rico*: Molonillo, Rascamoño—; *Sakalave*: Kilanjan-anahary—; *Santali*: Daredhompo, Janumdhompo, jonumdhompo—; *Sinhalese*: Mahayakwanassa—; *Telugu*: Beri, Hanumantabira, Mulugolimidi, Ranabheri—; *Uriya*: Kontosidho—; *Uruguay*: Uña del diablo—; *Yoruba*: Iku ekun—.

LEONURUS.

The genus consists of 8 species inhabiting Europe, Asia, and tropical regions.

L. macranthus Maxim. and *L. sibiricus* Linn. are used medicinally in China, and *L. sibiricus* is also used in Malaya; *L. Cardiaca* Linn. is used in Europe.

Upper lip of corolla densely villous, midlobe of lower lip entire ... ... *L. Cardiaca*
Upper lip of corolla tomentose, midlobe of lower lip obcordate or 2-fid ... ... *L. sibiricus.*

1. **Leonurus Cardiaca** Linn. is found in Kumaon, Kashmir, the Punjab, Hazara, and the Kurrum Valley. It is distributed to western and northern Asia, and to Europe.

Says Culpeper: 'There is no better herb to take melancholy vapours from the heart, and to strengthen it. It may be kept in a syrup or conserve; it maketh mothers joyful, and settles the womb, therefore it is called Motherwort. It is of use for the trembling of the heart, fainting and swooning. The powder, to the quantity of a spoonful, drank in wine, helps women in sore travail, as also for the suffocating or rising of the mother. It provokes

urine and women's courses, cleanses the chest of cold phlegm, kills the worms in the belly. It is of use to digest and disperse them that settle in the veins, joints, and sinews of the body, and to help cramps and convulsions.'

The herb is diaphoretic, aromatic, and stomachic.

Contact with the plant causes a dermatitis in susceptible individuals.

Catalan : Mà de Santa Maria— ; *English* : Motherwort— ; *French* : Agripaume, Cardiaire, Cardiale, Cardiaque, Cheneuse, Creneuse, Herbe aux tonneliers, Léonure, Patte de sorcier— ; *German* : Herzgespann, Loewenschwanz— ; *Italian* : Cardiaca— ; *Portuguese* : Cardiaca— ; *Roumanian* : Cione, Creasta cocosulin, Iarba flocoasa, Talpa gascei— ; *Russian* : Pustirnik— ; *Spanish* : Agripalma, Cardiaca, Cola de león— ; *United States* : Lion's Ear, Lion's Tail, Motherwort, Throwwort—.

2. **Leonurus sibiricus** Linn. is found in the plains of India from Bengal and Sylhet to Coorg. It is distributed to tropical Asia, Africa, and America.

The root and leaves are bitter and used as a febrifuge.

In Chinese medicine the seeds are considered to be constructive and aphrodisiac. The dried plant is prescribed as a tonic, alterative, vulnerary, and general remedy in puerperal and mentrual diseases.

Cantonese : Ch'ung wai— ; *Chinese* : Ch'ung Wei, I Mu, K'uen Ts'ao— ; *Malaya* : Choong wai, Kwan chor seranting, Tebung aga— ; *Patna* : Guma— ; *Tagalog* : Camariangsongsong—.

LEUCAS.

The genus includes about 100 Asiatic and African species.

L. aspera Spreng. is used medicinally in the Philippine Islands; *L. decurvata* Baker in Nyasaland; *R. deflexa* Hook. fil. in Gold Coast; *L. martinicensis* R. Br. in Northern Nigeria, South Africa, and Brazil.

A. Calyx-mouth oblique.
- I. Mouth of calyx much produced below ... *L. urticaefolia.*
- II. Mouth of calyx produced above
  Calyx-teeth very short
  - a. Calyx-mouth not villous within.
    - 1. Calyx smooth below, ribbed and hispid above ... ... *L. aspera.*
    - 2. Calyx smooth throughout or nearly so. Calyx-mouth very oblique ... *L. linifolia.*
  - b. Calyx-mouth villous within
    - 1. Leaves linear, less than 13 mm. broad, whorls less than 2.5 cm. diam.; bracts linear, 6 mm. long ... ... *L. zeylanica.*
    - 2. Leaves ovate, more than 13 mm. broad,
      - i. Whorls 3.5 cm. diam.; bracts lanceolate, 1.5-2.5 cm. long ... ... *L. Cephalotes.*
      - ii. Whorls 2.3 cm. diam.; bracts linear-lanceolate or subulate, 6-9 mm. long ... *L. martinicensis*

B. Calyx-teeth stellately spreading in fruit, whorls terminal and axillary.
  Hairs on the stem erect or spreading. Calyx 5-10 mm. long ... ... *L. stelligera.*

1. **Leucas aspera** Spreng. occurs more or less throughout India, in the plains. It extends to Indo-China, the Philippine Islands, Java, and Mauritius.

The leaves are said to be useful in chronic rheumatism. The juice is applied in psoriasis and other chronic skin eruptions.

In North Bengal the flowers are given warmed in a little honey for coughs and colds to children. The juice of the leaves is applied to disperse painful swellings.

In Mauritius the plant is used as an emollient and pectoral.

Caius and Mhaskar have shown experimentally that the plant is not an antidote to snake venom.

Bengal : Chotahalkusa— ; *Bombay* : Tamba— ; *Deccan* : Thurduribaji— ; *Hindi* : Chotahalkusa— ; *La Reunion* : Herbe à mouches, Herbe Tombe, Tombe— ; *Mauritius* : Madame Tombé, Marrube blanc, Couma, Halkasa, Poualla toumi— ; *Mundari* : Gomaara— ; *Sadani* : Gumhasag— ; *Tagalog* : Carucansoli, Pansipansi, Solasolasian— ; *Tamil* : Tumbai— ; *Telugu* : Tummachettu— ; *Visayan* : Paipaisi, Pansipansi, Paypaysi—.

2. **Leucas Cephalotes** Spreng. is found throughout India from Sind to Assam, and Kashmir to Deccan; scattered over all plains districts of the Madras Presidency. It extends to Afghanistan.

The plant is considered a mild stimulant and diaphoretic, and is considerably used in fevers and coughs.

The fresh juice is used in certain localities as an external application in scabies. The flowers are administered in the form of a syrup as a domestic remedy for coughs and colds.

The seeds yield an oil, which is used medicinally in Chota Nagpur.

The leaves, in combination with other drugs, are prescribed for scorpion sting (Vagbhata); but they are not an antidote to scorpion venom (Caius and Mhaskar).

Bengal : Barahalkasa, Ghalaghase— ; *Gangpur* : Nakiara, Nakingara— ; *Gujerati* : Doshinokubo, Khetraukubo, Kubi, Kubo— ; *Hindi* : Deldóna, Dhurpisag, Goma, Guma, Motapati— ; *Khandesh* : Kedari— ; *Marathi* : Devkumbha, Kumbha, Shetvad, Tumba— ; *Mundari* : Bananaki, Gomanaki— ; *Punjab* : Chatra, Guldoda, Maldoda, Phuman, Sisalius— ; *Sanskrit* : Chatraka, Chhatrani, Chitrakshupa, Chitrapatrika, Drona, Dronapushpi, Kaundinya, Kshavapatri, Kumbhayoni, Kumbhayonika, Kurumba, Kurumbika, Palindi, Phalepushpa, Shvasanaka, Supushpi, Vrikshasaraka— ; *Santali* : Andiadhuruparak, Andiadura parak— ; *Telugu* : Peddatumni, Tumni—.

3. **Leucas linifolia** Spreng. is met with in the plains, more or less throughout India. It is distributed to Malaya and Mauritius.

The natives of Central India believe that the leaves, when roasted and eaten with salt, have febrifugal properties.

The fresh juice is employed as a remedy against headaches and colds.

At Lakhimpur in Assam it is used for loss of appetite. The leaves are wrapped up in a plantain leaf, heated, and then eaten. The first effect of this treatment is that the appetite decreases to such an extent that the patient is unable to take any food at all, on the second day it passes off and he takes food with avidity (Carter).

In the North West, the leaves are bruised and a teaspoonful of juice given, which is snuffed up the nostrils as a remedy against snake-bite.

The leaves are equally useless in the treatment of snake-bite whether given internally, or used as an errhine or a collyrium, or applied locally to the part bitten (Mhaskar and Caius).

Assam: Dron—; *Bengal*: Halkasa, Halkussa—; *Deccan*: Goma—; *Gond*: Gumi, Kumbha—; *Gujerati*: Jhinanpannikubo—; *Hindi*: Guma, Halkusa, Kumbha—; *Lakhimpur*: Guma—; *La Reunion*: Herbe à mouches, Herbe Tombe, Tombe—; *Marathi*: Kuva—; *Philippines*: Parnipansi—; *Sanskrit*: Dronapushpi, Kumbhi, Rudrapushpa—; *Sundribuns*: Guma, Hal-kūsa—; *Telugu*: Pulátumni—; *Urdu*: Guma—.

4. **Leucas martinicensis** R. Br. is found all over South India. It is distributed to the Malay Peninsula, tropical Africa, and tropical America.

In Gambia the whole plant is made into an infusion and used as a wash in fevers.

In Northern Nigeria the plant is burnt for the purpose of expelling mosquitoes. An infusion is used for simple gastro-intestinal troubles and for colds, and as a wash or steam for fevers.

The infusion is used in Brazil as a bath for hysterical fits and for pain in the joints.

Betsileo: Kifilanjambola—; *Brazil*: Catinga da Mulata—; *Fulani*: Erisku, Hore gujjo, Risku—; *Gambia*: Wild Tea Bush—; *Hausa*: Kam'barawo—; *Hova*: Lanjananahary—; *Katsina*: Sarakuwar sauro—; *Sokoto*: Sarakuwar sauro—; *Zaria*: 'Dai'doyar gona—.

5. **Leucas stelligera** Wall. is found in the Konkan, Canara, Mysore, and the Nilgiris.

The plant has stimulant, carminative, and emmenagogue properties.

Gujerati: Dungaraukubo—; *Laos*: Jang nog gan—; *Marathi*: Barumbi, Guma—; *Matheran*: Borambi, Guma, Matasul—.

6. **Leucas urticaefolia** R. Br. occurs from Baluchistan and the Punjab to Behar, Sind, Gujerat, Rajputana, Central and South India, mostly in the plains. It is distributed to Arabia, Nubia, and Abyssinia.

At Gomawal in Baluchistan the plant is used as a cure for fever.

Gujerat: Kubo—.

7. **Leucas zeylanica** R. Br. occurs in Assam, Chittagong, and South India, whence it spreads to Ceylon. It extends to the Malay Peninsula and Archipelago, and to China.

In Malaya the herb is used as a cure for scabies.

In Ceylon the leaves are bruised and a teaspoonful of the juice given, which is sniffed up as a remedy in snake-bite. The juice is also employed in headache and colds.

The leaves are useless as an errhine in the treatment of snake-bite (Mhaskar and Caius).

Malay: Katumbit—; *Sinhalese*: Gattatumba, Getatumba—.

LYCOPUS.

This genus includes 10 species of the northern temperate regions.

L. sinuatus Ell. and *L. virginicus* Linn. are used medicinally in the United States of America.

Lycopus europaeus Linn. is found in Kashmir. It is distributed to Europe, West, North, and Central Asia.

The leaves are used externally as a poultice to cleanse foul wounds.

It is used in the Punjab as a cooling drug.

It has been employed in Europe as a substitute for quinine.

English : Gipsywort— ; *French* : Marube aquatique— ; *German* : Wolfsfuss— ; *Kashmir* : Gandamgundu, Jalnim— ; *Spanish* : Marrubio acuático, Pie de lobo—.

MARRUBIUM.

The genus includes 30 species, natives of Europe, North Africa, and temperate Asia.

M. Alysson Linn. is used medicinally in Spain; *M. vulgare* Linn. in Europe, California, and South Africa.

Marrubium vulgare Linn. occurs in Kashmir, the North West Frontier Province, and Baluchistan, whence it extends to Afghanistan, Europe, and North Africa.

The dried leaves and flowering tops are carminative. expectorant, laxative, aperient, diaphoretic, stimulant, and tonic.

The herb is a bitter tonic, expectorant, and diuretic. It is perhaps the most popular of herbal pectoral remedies in England. It is exceedingly valuable in coughs, cold, and pulmonary affections. In many parts it is brewed and sold as Horehound Ale, making an appetising and healthful beverage. Also a candy is prepared, and if properly made, is no doubt efficacious.

The infusion is much used in Europe as a domestic remedy for bronchitis with profuse expectoration. It is tonic, and in large doses, purgative.

The Europeans in South Africa use an infusion in febrile conditions, and especially in typhoid fever.

In America it is generally used in catarrhal states of the air passages.

The plant is especially esteemed by the Spanish-Californians as a remedy for colds and lung troubles.

In Mexico a preparation made from the leaves is used for rheumatism; it is added to mescal and applied as a liniment.

Afrikaans : Koorsbossie— ; *Arabic* : Faracioūn, Farasiym, Hashishatelkalb, Sufelard— ; *Brahui* : Borkash— ; *Catalan* : Malroig, Malrubé, Malrubi blanch, Malrubins, Marreus— ; *Danish* : Hvidmarru, Hvidrubike, Rubike— ; *Dutch* : Gemeene malrove— ; *English* : Common Horehound, Hoarhound, Horehound, White Hoarhound— ; *French* : Blanc roubi, Blanc rubi, Bonhomme, Bon riblet, Bon rubi, Grand bonhomme, Herbe vierge, Marchemin, Marinclin, Marrochemin, Marrochen, Marrube, Marrube blanc, Marrube bonhomme, Marrube commun, Mont blanc— ; *German* : Andornkraut, Berghopfen, Chinakraut, Gotteshuelfe, Gottvergess, Gutverges, Kuckskraut, Lungenkraute, Maeuseoehrchen, Marienwurzelkraut, Markobell, Nagelkraut, Siebennagelspitzer, Wasserdorn, Weisse Leuchte,

Weisser Andorn, Weisser Anton, Weisser Daurand, Weisser Dorand, Weisser Gottvergess, Weisser Winderthon, Weissleuchterkraut—; *Greek*: Prasion—; *Hindi*: Paharigandana—; *Italian*: Erba apiola, Marrobio, Marrobio bianco—; *Kurdish*: Qutainah—; *Languedoc*: Maltraste, Maribbe—; *Malta*: White Horehound, Marrobio, Robbio, Erba apiola, Marrubija, Marrubjabajda—; *Persian*: Afnanesar—; *Polish*: Szanta biala—; *Portuguese*: Marroio, Marroio branco—; *Provence*: Bouan rible, Mentastre, Marroufe, Marrubi, Moun blanc—; *Roumanian*: Catusnica, Catusnica selbatica, Iarba flocoasa, Iarba mitei, Iarba vintului—; *Russian*: Marrub, Schandra—; *South Africa*: Horehound, Marvel, White Horehound—; *Spanish*: Marrubio, Marrubio blanco—; *Swedish*: Andorn—; *Urdu*: Farasiym—; *Uruguay*: Malva rubia, Marrubio, Yuyo del sapo—.

Melissa.

A genus of 4 species, natives of Europe and Western Asia.

M. officinalis Linn. is used medicinally in Europe. Its flower-heads and leaves are official in Austria, Belgium, Brazil, Denmark, France, Germany, Hungary, Italy, Norway, Portugal, Spain, Switzerland, Turkey, and Yugoslavia.

Melissa parviflora Benth. occurs in the temperate Himalaya, from Garhwal to Sikkim and Mishmi, and in the Khasia Hills. It is distributed to Java.

The plant is a good substitute for *M. officinalis*.

Arabic: Baklatelutrujiya, Mufarehulkalab—; *Hindi*: Bililotan—; *Persian*: Badrunjboya—; *Urdu*: Baranjboya—.

Mentha.

The genus includes 25 Old World species.

The following species are used medicinally in Europe:—*M. aquatica* Linn., *M. arvensis* Linn., *M. cardiaca* J. G. Baker, *M. gentilis* Linn,, *M. piperita* Linn., *M. Pulegium* Linn., *M. rotundifolia* Huds., *M. sativa* Linn., *M. sylvestris* Linn., *M. viridis* Linn.—; in China, Indo-China, and Malaya—*M. arvensis* Linn.—; in Madagascar—*Mentha spp.*—; in South Africa—*M. aquatica* Linn., *M. capensis* Thunb., *M. crispa* Linn., *M. longifolia* Huds.—; in North America—*M. aquatica* Linn., *M. piperita* Linn., *M. sylvestris* Linn .—.

1. Leaves sessile, lanceolate to oblong, coarsely dentate, smooth above, glandular below ... ... *M. viridis.*
2. Leaves petioled, coarsely serrate, smooth above, rarely sparingly hairy on the nerves below ... ... *M. piperita.*
3. Leaves nearly sessile, sharply toothed, upper surface hoary pubescent, lower white tomentose ... ... *M. sylvestris.*
4. Leaves narrowed below, stalked, ovate, oblong, lanceolate, toothed ... ... *M. arvensis.*

1. **Mentha arvensis** Linn. is a herb of the Western Himalaya, found in Kashmir, the Punjab, Kumaon, and Garhwal. It is distributed to Afghanistan, West and North Asia, China, and Europe.

The dried plant is refrigerant, stomachic, diuretic, and stimulant. It possesses antispasmodic and emmenagogue properties. It is used in jaundice, and is frequently given to stop vomiting.

In China the leaves and stems are made into infusion, and used as carminative, sudorific, and antispasmodic.

In Annam the plant is considered an excellent diaphoretic. An infusion is given in fevers, indigestion, and cephalalgia. The juice of the leaves is applied to the sting or bite of poisonous animals. The leaves pounded with salt are applied to the whitlow.

It is said that the effect of this plant, when animals eat it, is to prevent coagulation of their milk, so that it can hardly be made to yield cheese.

Annam : Bac ha, Bac ha tay, Ke to, Kim tien bac ha, Nam ha, Thuy to, To lan—; *Arabic* : Fodanajihindi, Fotanajehindi, Habakjabuli, Habaqulhind, Naanaaehindi, Naanaaulhind—; *Bengal* : Podina—; *Bombay* : Pudinah—; *Burma* : Bhudina—; *Canarese* : Chetnimaragu, Maraga—; *Chinese* : Po Ho—; *English* : Chinese Mint, Corn Mint, Marsh Mint—; *French* : Baume des champs, Menthe des champs, Menthe du Japon, Pouliot thym—; *Guam* : Yerba buena—; *Gujerati* : Phudno, Pudina—; *Hindi* : Pudinah—; *Languedoc* : Fau pulegi—; *Malaya* : Pok ho—; *Malayalam* : Putiyina—; *Marathi* : Pudina—; *Persian* : Filfilmun, Pudinah—; *Sind* : Pfudnah—; *Sinhalese* : Odutalan—; *Spanish* : Yerba buena—; *Tamil* : Pudina, Yechakkirai—; *Telugu* : Igaenglikura, Pudina—; *Tongking* : Ba Kha—; *Urdu* : Pudinchkohi—.

2. **Mentha piperita** Linn. is cultivated in Indian gardens. It is found spontaneous and cultivated in most temperate regions of Europe, Asia, and North America.

The leaves and the tops of the flowering plant are carminative, stimulant, nervine, antispasmodic, analgesic, anodyne.

In Europe the herb is considered stimulant, stomachic, carminative; and is used for allaying nausea, flatulence, sickness, vomiting, and as an infants' cordial.

Its bruised fresh leaves, if applied, will relieve local pains and headache. A hot infusion, taken as tea, soothes stomach-ache, allays sickness, and stays colicky diarrhoea. This will also subdue menstrual colic.

This is one of the three plants used by the Menomini Indians of North America in the cure of pneumonia, the others being wild mint and catnep. The compound is drunk in the form of a tea and is also used as a poultice.

A volatile oil obtained from the plant is well-known in medicine for its antiseptic, stimulant, and carminative properties; and peppermint oil is the most extensively used of all the volatile oils, both medicinally and commercially.

The oil itself is often given on sugar and added to pills, also a spirit made from the oil, but the preparation in most general use is Peppermint Water, which is the oil and water distilled together. In flatulent colic, spirit of Peppermint in hot water is a good household remedy, also the oil given in doses of one or two drops on sugar.

The local anaesthetic action of Peppermint Oil is exceptionally strong. It is also powerfully antiseptic, the two properties making it valuable in the relief of toothache and in the treatment of cavities in the teeth.

Rats dislike Peppermint, a fact that is made use of by ratcatchers, who, when clearing a building of rats, will block up most of their

holes with rags soaked in oil of Peppermint, and drive them by ferrets through the remaining holes into bags.

Arabic: Nāna—; *Berber*: Nemdar, Timedja, Timersitin—; *Bogotá*: Yerba buena—; *Brazil*: Hortela pimenta—; *Catalan*: Menta piperita—; *Chinese*: Po Ho—; *Danish*: Pebermynte—; *Dutch*: Pepermint—; *English*: Brandy Mint, Peppermint—; *French*: Menthe, Menthe anglaise, Menthe d' Angleterre, Menthe officinale, Menthe poivrée—; *German*: Edelmindkraut, Edelminze, Hausminze, Odernunze, Pfefferminze, Pfeffermuenze—; *Hungarian*: Borsos menta—; *Italian*: Menta piperita—; *Menomini*: Dakixkomik—; *Mexico*: Menta piperita—; *North America*: Brandy Mint, Lamb Mint, Lammint, Peppermint—; *Norwegian*: Peppermynte—; *Polish*: Pepparmynta—; *Portuguese*: Hortelana pimentosa, Hortelao apimentada, Hortelao pimenta—; *Russian*: Myata perechnaya—; *Spanish*: Menta inglesa, Menta pimentada, Menta piperita, Yerba buena de sabor de pimienta—; *Swedish*: Pepparmynt—; *Turkish*: Nana—; *Uruguay*: Menta—; *Yugoslavia*: Paprena metvica, Nana—.

3. **Mentha sylvestris** Linn. is met with in the temperate Western Himalaya and Western Tibet, at altitudes of 4,000 to 12,000 feet; in Kashmir, Kumaon, Garhwal, and the Punjab. It is distributed to Afghanistan, Western and Central Asia, and temperate Europe. It is frequently cultivated in gardens in the plains of India.

The dried leaves and flower heads are carminative, and stimulant.

The leaves and a decoction of the plant are considerably used by the natives of the Himalaya as a carminative. They are also employed as an astringent, and for rheumatic pains.

The leaves soaked in water give an infusion which is drunk as a cooling medicine in Shahrig. Trans-Indus, a decoction is used in fever and heat apoplexy.

In the Konkan the plant is much used as a domestic remedy on account of its mildly stimulant and carminative properties.

The herb is used as a carminative and stimulant in Europe. The dry herb yields about 1 per cent of essential oil, endowed with the same carminative and stimulant properties.

Arabic: Fudanajhabak, Fudanajnaanna—; *Baluchi*: Purchink—; *Bombay*: Pudina, Vartalau—; *Brahui*: Purchink—; *Burma*: Boodeema—; *Catalan*: Menta borda—; *Egypt*: Habag—; *English*: Horsemint—; *French*: Mentastre, Menthe sauvage—; *Hindi*: Podina—; *Khowas*: Wealni—; *North-Western Provinces*: Padina—; *Punjab*: Baburi, Belanne, Koshu, Pudnakushna, Vien, Yura—; *Pushtu*: Shamshabai—; *Sanskrit*: Ajirnahara, Pudina, Rochani, Ruchishya, Shakashobaana, Sugandhipatra, Vantihara, Vyanjana—; *Shahrig*: Shinshobae, Velanac, Vialangi—; *Spanish*: Mastranzo nevado, Menta silvestre—; *Urdu*: Pudina—; *Uruguay*: Menta—; *Zhob*: Shinshobae—.

4. **Mentha viridis** Linn. is commonly grown in native gardens all over the plains of India.

The seeds are mucilaginous. The leaves are given in fever and bronchitis, and a decoction is used as lotion in aphthae.

In Europe the herb is considered stimulant, carminative, and antispasmodic. It is added to many compounds on account of its carminative properties and its pleasant taste. For infantile troubles generally the sweetened infusion is an excellent remedy. A distilled water is made which will relieve hiccough and flatulence as well as the giddiness of indigestion.

The oil is less used than that of Peppermint.

A homoeopathic tincture prepared from the fresh plant in flower has been found serviceable in strangury, gravel, and as a local application in painful haemorrhoids. Its principal employment is for its febrifuge and diuretic properties.

Bengal: Pundia—; *Bombay*: Pahadipudina, Pudina—; *Brazil*: Hortela commum—; *Catalan*: Herba sana, Menta comuna—; *English*: Brown Mint, Fish Mint, Garden Mint, Green Mint, Lamb Mint, Mackerel Mint, Our Lady's Mint, Sage of Bethlehem, Spearmint, Spire Mint—; *French*: Baume vert, Menthe à épis, Menthe de Notre-Dame, Menthe romaine, Menthe verte—; *German*: Frauenmuenze, Gruene Muenze, Roemische Minze—; *Gujerati*: Phudino—; *Hindi*: Paharipudina, Podina—; *Italian*: Menta romana—; *Malta*: Spearmint, Menta comune, Naghnieh—; *Marathi*: Pudina—; *Mexico*: Herbabuena—; *North-Western Provinces*: Paharipudina—; *Persian*: Nagbo, Pudneh, Shahsufiam—; *Pishin*: Nana—; *Portuguese*: Hortelao, Ortelao vulgare—; *Punjab*: Paharipodina, Pudina, Pudinakuhi, *Pudna*—; Quetta: Nana—; *Roumanian*: Izma, Minta—; *Sind*: Phudina, Pudina—; *Sinhalese*: Meenchi—; *Spanish*: Costo, Erba Santa Maria, Menta romana, Yerba buena—; *Telugu*: Pudina—.

MERIANDRA.

This genus consists of 2 species, one Himalayan, and one Abyssinian.

Shrub finely tomentose or hoary. Spikes with distant clusters of flowers	... *M. bengalensis.*
Shrub flocculently woolly. Spikes uninterrupted	... *M. strobilifera.*

1. **Meriandra bengalensis** Benth., a native of Abyssinia, is cultivated in most of the provinces in India.

An infusion of the leaves is a useful application to aphthae and sore throats. It diminishes or arrests the secretion of milk.

Bombay: Kafurkapatta, Sesti—; *Deccan*: Kafurkapatta—; *English*: Bengal Sage—; *Hindi*: Kafurkapat—; *Tamil*: Sayayilai—; *Telugu*: Simakarpuramu—.

2. **Meriandra strobilifera** Benth. is found in the western temperate Himalaya, from Simla to Kumaon, at altitudes of 5,000 to 6,000 feet.

The decoction, when made strong, is a good lotion for ulcers and heals raw abrasions of the skin. It dries up the breast milk.

MICROMERIA.

The genus includes 130 cosmopolitan species.

M. Douglasii Benth. is used popularly as an emmenagogue along the Pacific Coast.

Micromeria capitellata Benth. occurs in Kumaon and Dehra Dun, the Upper Gangetic Plain, Chota Nagpur, Bihar, the Western Ghats, the Northern Circars, and the Nilgiris.

It is a fairly good substitute for *Mentha piperita.*

Moschosma.

The genus consists of 6 palaeotropical species.

Moschosma polystachium Benth. is found in Gujerat, Konkan, Deccan, Bengal, Bihar, and Burma. It extends to Ceylon, Java, the Philippine Islands, China, Australia, and tropical Africa.

In the Gold Coast Colony the juice of the plant is squeezed into the nostrils of children to cure headache.

Ashanti: Nwansing nwansing—; *Betsileo*: Karanjamboay, Karanjanamboay— *Hausa*: Kimbar rafi—; *Tamil*: Sanakki poondu—.

Nepeta.

The genus includes 150 species, natives of temperate Europe, North Africa, and Asia.

The following species are used medicinally in Europe—*N. Cataria* Linn., *N. glechoma* Benth., *N. italica* Linn.—; in China—*N. glechoma* Benth., *N. japonica* Maxim., *N. tenuifolia* Benth.—; in Annam and Malaya—*N. tenuifolia* Benth.—; in the United States of America—*N. glechoma* Benth.—.

I. Flowers in continuous spikes or heads; basal clusters rarely distinct ... ... *N. elliptica.*

II. Flowers in distinct clusters either axillary, or forming interrupted spikes or panicles.

- A. Whorls all sessile.
  1. Leaves as broad as long; hoary on both sides ... *N. glomerulosa.*
  2. Leaves longer than broad, upper surface not hoary ... *N. ciliaris.*
- B. Whorls peduncled, the lower conspicuously so.
  1. Stem and branches stout; leaf-apex acute or acuminate; corolla dotted with purple ... *N. Cataria.*
  2. Stem and branches slender; leaf-apex obtuse; corolla blue-purple ... ... *N. ruderalis.*

1. **Nepeta Cataria** Linn. is found in Kashmir, the North-Western Frontier Province, the Kurrum Valley, Baluchistan, and Afghanistan. It is distributed to Western Europe.

The dried leaves and flowering tops are carminative, tonic, diaphoretic, refrigerant and slightly emmenagogue, specially antispasmodic, and mildly stimulating.

Producing free perspiration, Catnep Tea is very useful in colds. It is a valuable drink in every case of fever, because of its action in inducing sleep, and producing perspiration without increasing the heat of the system. It is good in restlessness, colic, insanity, and nervousness, and is used as a mild nervine for children, one of its chief uses being, indeed, in the treatment of children's ailments.

The infusion of 1 oz. to a pint of boiling water may be taken by adults in doses of two tablespoonfuls, by children in two or three teaspoonfuls frequently, to relieve pain and flatulence. The tea may be drunk freely, but if taken in very large doses when warm,

it frequently acts as an emetic. It has proved efficacious in nervous headaches and as an emmenagogue, though for the latter purpose, it is preferable to use Catnep, not as a warm tea, but to express the juice of the green herb and take it in tablespoonful doses, three times a day.

An injection of the tea also relieves headache, hysteria, and colicky pains.

Catmint is one of the ingredients in the Menomini Indian cure for pneumonia, the others being wild mint and peppermint. The compound is drunk in the form of a tea, and is also used as a poultice on the chest.

The Flambeau Ojibwe brew a tea of catmint leaves for a blood purifier. The mint water obtained by steeping the herb in lukewarm water is used to bathe a patient, to raise the body temperature.

Catalan : Herba gatera, Menta de gat, Nepta— ; *Dutch* : Kattekruid, Nip— ; *English* : Catmint, Catnep, Nep— ; *Flambeau Ojibwe* : Tci'name'wûck— ; *French* : Cataire, Chataire, Herbe aux chats, Menthe de chat— ; *German* : Katzenminze, Katzennessel, Katzensterz, Neptenkraut, Steinminze, Steinnessel— ; *Italian* : Cattaia, Cattaria, Erba gatta, Gattaria, Nepitella— ; *Menomini* : Ka'saka muski'ki— ; *North America* : Catmint, Catnep, Catnip— ; *Roumanian* : Catusnic, Catusnica— ; *Russian* : Kashachya myata— ; *Spanish* : Menta gatera, Menta de gatos, Yerba gatera, Yerba de gatos— ; *Swedish* : Kattmynta—.

2. **Nepeta ciliaris** Benth. is found in temperate western Himalaya, from Kashmir to Garhwal, at altitudes of 6,000 to 8,000 feet.

It is given in sherbet for fever and cough.

Punjab : Zufa yabis— ; *Sind* : Jufa—.

3. **Nepeta elliptica** Royle occurs in western temperate Himalaya, from Kashmir to Kumaon, at altitudes of 5,000 to 8,000 feet.

An infusion of seeds in cold water is used in dysentery by the Punjabis.

Punjab : Tukhmmalanga—.

4. **Nepeta glomerulosa** Boiss. is found from the Punjab frontier to Baluchistan, whence it extends to Afghanistan and Persia.

It is a cure for pneumonia in Bolan, for itch in Sanjawi.

It is commonly used for indigestion.

Bolan : Simsok— ; *Brahui* : Simsok— ; *Chiltan* : Bhinjanbutai, Chanjanbutai— ; *Quetta-Pishin* : Chinjanbutae— ; *Sanjawi* : Chamjanbot—.

5. **Nepeta ruderalis** Hook. fil. occurs in the hilly parts of Bengal, Bihar, the Punjab, Kumaon, the North-West Frontier Province, Rajputana, Central India, Konkan, and Deccan. It is distributed to Afghanistan.

It is largely used in fevers, and as a cardiac tonic. The decoction is used as a gargle in sore throat.

In Nepal it is taken internally as a remedy for gonorrhoea.

Nepal : Niasbo— ; *Punjab* : Badranj boya, Bebrang khatai, Billi lotan—.

OCIMUM.

The genus numbers 60 species, inhabiting the tropical and warm temperate regions of the world.

The following species are used medicinally in Europe—*O. basilicum* Linn., *O. gratissimum* Linn.—; in China and Indo-China—*O. basilicum* Linn.—; in Japan and Malaya—*O. crispum* Thunb.—; in the Philippine Islands—*O. basilicum* Linn., *O. gratissimum* Linn., *O. sanctum* Linn.—; in Guiana— *O. micranthum* Willd.—; in Brazil—*O. canum* Sims., *O. gratissimum* Linn., *O. micranthum* Willd.—; in La Reunion—*O. basilicum* Linn., *O. gratissimum* Linn.—; in Ethiopia and Abyssinia—*O. gratissimum* Linn.—; in Guinea and the Gold Coast—*O. canum* Sims., *O. basilicum* Linn., *O. viride* Willd.—; in Sierra Leone and Liberia—*O. viride* Willd.—; in Ubangi-Shari : *O. canum* Sims.—.

The flower tops of *O. basilicum* Linn. are official in France.

A. Pedicels as long as or longer than the calyx ; 2 lower calyx-teeth longer than the upper lip ... ... *O. sanctum.*

B. Pedicels shorter than the calyx.
- I. Lower calyx-teeth longer than the upper lip.
  - a. Bracts stalked ... ... *O. canum.*
  - b. Bracts stalked. Fruiting calyx very shortly pedicelled *O. basilicum.*
- II. Lower calyx-teeth shorter than the upper lip ... *O. gratissimum.*

1. **Ocimum basilicum** Linn. grows throughout India. It is cultivated throughout the greater part of India, Ceylon, and Burma. It extends to the Malay Peninsula and Archipelago, Formosa, China, and Polynesia.

Diaphoretic and expectorant properties are ascribed to this plant, which is considered digestive and pectoral in La Reunion.

The roots are used for the bowel complaints of children.

The leaves are useful in the treatment of croup, for which the juice warmed with honey is given.

The expressed juice of the leaves forms the basis of a celebrated nostrum for the cure of ringworm; and the bruised leaves are applied to parts stung by scorpions to lessen the pain. The powdered dried leaves are said to be an effectual means of dislodging maggots.

The juice of the leaves or of the whole plant is dropped into the ears for the cure of headache and dullness of hearing. Mixed with ginger and black pepper it is given in the cold stage of intermittent fever.

The flowers possess stimulant, diuretic, and demulcent properties.

The seeds are largely employed, especially by the Mohammedans of Eastern Bengal, infused in water, to form a refreshing and cooling drink. When steeped in water they become immediately coated with a semi-transparent mucilage, and then form a mucilaginous jelly.

The seeds are much used medicinally in some parts of India, especially in the treatment of gonorrhoea and nephritic affections, and are regarded also as useful for dysentery and diarrhoea, especially in children for the diarrhoea of dentition. A cold infusion is said to relieve the after-pains of parturition.

The seeds washed and pounded are used in poultices for unhealthy sores and sinuses. They are also given internally with sherbet in cases of habitual constipation, internal piles, and fevers.

An infusion of the leaves is used in fevers by the natives of Gambia, where it is a popular common cooling drink.

In Guinea the decoction of the leaves and the stems is given in fevers, neuralgia, catarrh, and renal troubles; it is also used as a lotion for sore eyes.

In Annam an infusion of the plant is considered antiemetic and antidiarrhaeic. It is given for cephalalgia and gouty joints, and used as a gargle for foul breath. An infusion of the seeds is given in fevers. The seeds are chewed in cases of snake-bite, one portion is swallowed and the other portion applied to the bitten part.

The leaf is not an antidote to snake venom. In the treatment of snake-bite it is equally useless as a collyrium, an errhine, and a local application to the part bitten (Mhaskar and Caius).

Annam : Huong nhung, Nhat thong chi, Rau e lon trong, Rau e tia, Rau e trang, Rau que—; *Arabic* : Asaba-ul-feteyat, Badarwaj, Badruj, Baklut-ul-zub, Habaq, Habbok, Hebak, Hibag, Rihan, Schogor, Shahasfaram—; *Baluchi* : Nazbu—; *Bengal* : Babuitulsi, Debunsha, Khubkalam, Pashanabeddie—; *Bombay* : Takmeria—; *Brahui* : Niazpu—; *Canarese* : Kamkusturi, Ramkasturi, Sajjebiya—; *Cantonese* : Hiang Hoa Tsao—; *Catalan* : Alfabrega de fulla ampla, Alfabrega de fulla petita—; *Chinese* : Hsun Ts'ao, Lo le—; *Culión* : Camange—; *Deccan* : Salzat, Subjah, Subze, Tirunitru—; *Dutch* : Basilienkruid, Basilikum—; *Egypt* : Rihan, Sa'atar hendy—; *English* : Basil, Common Basil, Common Sweet Basil, Garden Basil, Roman Basil, Sweet Basil—; *French* : Basilic, Basilic des cuisinières, Basilic cultivé, Basilic aux sauces, Grand basilic, Herbe royale—; *Fulani* : Soukora—; *Gambia* : Patmagi—; *German* : Basilienkraut, Basilikum, Koenigskraut—; *Greek* : Basilikos, Okimon—; *Guam* : Atbahakat—; *Gujerat* : Damaro, Damro, Nasabo, Sabje—; *Hamadan* : Tukhm-i-raihan—; *Hausa* : Deidoya, Dodoya, Doidoya—; *Hindi* : Babuitulsi, Babul, Bahari, Barbar, Kalitulsi, Niyakshbo, Rihan, Sabzah, Tukhmerihan—; *Ho* : Loba—; *Iraq* : Raihan—; *Italian* : Basilico, Bassilico, Ocimo, Ozzimo—; *Kathiawar* : Marvo—; *Kurdish* : Ruhan—; *Lagos* : Efirin wewe—; *Languedoc* : Embaimo—; *La Reunion* : Grand basilic—; *Las Bela* : Drar khatori—; *Malay* : Kemangi, Pokoh, Pokoh-pokoh hitam, Ruku, Ruku-ruku, Ruku-ruku itam, Selaseh hitam, Selaseh puteh, Selasih, Selasih antan—; *Malayalam* : Pachcha, Tirunitru—; *Malinke* : Sossoguena, Soughenfira—; *Marathi* : Marya, Sabja, Sabza, Tukhamariya—; *Mauritius* : Basilic à grandes feuilles—; *Peking* : Gai K'ang—; *Persian* : Dabanshah, Firanjmushk, Nazbu, Rehan-e-dash, Reyhane sibze, Tur-eh-korasani, Ungusht-kunizuckan—; *Polish* : Bazylik—; *Porebunder* : Marvi, Takmario—; *Porto Rico* : Albahaca—; *Portuguese* : Alfabaca, Mangericoo—; *Punjab* : Babri, Baburi, Purrunj mushk, Nigand, Niyazbo, Panr, Rehan, Tulsi—; *Roumanian* : Busuioc—; *Russian* : Bazilik—; *Sanskrit* : Ajaganothika, Apetarakhsasi, Asurasa, Barba, Barbara, Barbari, Karahi, Kharapushpa, Manjariki, Munjariki, Surabhi, Surasa, Tulasidvesha, Tungi, Varvara—; *Santali* : Bharbari, Dimbubaha, Malibuha—; *Serbian* : Bosilek, Bosiliak—; *Sind* : Nazbo, Sabajhi—; *Sinhalese* : Hintala, Sawandatala, Suwandutala—; *Spanish* : Albahaca, Albahaca fina, Albahaca de hoja ancha—; *Tagalog* : Solasi, Sulasi—; *Tamil* : Tirnutpatchi, Tirunitru—; *Telugu* : Bhutulasi, Rudrajada, Vepudupachcha, Vibudipatri—; *Tongking* : Hung gioi—; *Urdu* : Janglitulasi—; *Uriya* : Dhalatulasi—; *Visayan* : Bonac, Calooy, Canela—; *Yemen* : Hehak, Raihan—.

2. **Ocimum canum** Sims is found on the plains and lower hills of India, from Assam, Bengal, Bihar, and Central India, to the south Deccan and Ceylon. It is distributed to Java, Western Asia, tropical Africa, Madagascar; and is cultivated in America.

Among the Santals, during fever when the extremities are cold, the leaves made into a paste are applied to the finger—and toe-nails. The same preparation is used as a cure for parasitical diseases of the skin.

In Jodhpur the seeds are drunk in milk as a tonic; and a decoction of them with potash in water is used as a cooling drink in fever. A bunch of the plant hung in the corner of a room is said to attract mosquitoes and keep the rest of the room free from them.

In Persia the mucilaginous seeds are given for lung and chest complaints.

In French Guinea the herb is especially used by women before parturition, or as an emmenagogue, the leaves cooked with groundnuts taken in small quantity.

In Ubangi Shari the decoction of the leaves is given to women after they have been delivered, as also to the newly born infant. The leaves ground in oil are applied to the temples for headache. Boiled with yam or maize flower they yield a pleasantly-flavoured soup which is eaten as a cure for cough, and bronchitis.

The plant is commonly grown in gardens in Tropical West Africa and used as 'tea leaf' for fevers, often given to children, or as a bath for febrile patients, the patient sitting and pouring it over the head, or with clothing opened out over a pot in which abundance of the plant is boiled. In Gold Coast the juice of the leaves is sometimes squeezed into the patient's eyes. At Accra a decoction is also given for dysentery, or as a mouth-wash to relieve tooth-ache.

For haemorrhage from the nose, the Sutos either inhale the smoke from burning the dried leaf or apply an ointment made with the powdered leaf.

In Madagascar the leaves and the seeds are considered aromatic, tonic, febrifuge, anticatarrhal, expectorant, sternutatory, anti-rheumatismal. For malaria the seeds are ground in an infusion of the leaves. The juice and the powder obtained by pounding together the seeds and the leaves are taken as an errhine in migraine.

Adangme: Danwe—; *Awuna*: Ahame, Defetsui—; *Bambara*: Chukula—; *Bengal*: Bharbari—: *Benin*: Ihiri—; *Bombay*: Ramtulsi—; *Canarese*: Nayi-tulasi, Ramatulasi—; *Efik*: Amana, Mfang—; *English*: American Basil, Hairy Basil, Hoary Basil, Hoary Tulsi, White Basil—; *Espiritu Santo*: Neruk—; *Ewe*: Ahame, Defetsui—; *French*: Basilic d'Amérique, Basilic commun—; *Fulani*: Katchukatchunga, Sukora, Urngol—; *Ga*: Kowe—; *Gbari*: Jemijemi—; *Gbaya*: Wélé—; *Golungo Alto*: Machericao, N-xilica—; *Guam*: Atbahakat—; *Hamadan*: Tukhm-i-sherbati—; *Hausa*: 'Da'ddoya, 'Dai'doya, 'Dai'doyar masar, 'Do'dowa, 'Do 'doya, 'Dwai'dwaiya, Sarakuwar sauro, 'Yar kan masallachi—; *Ho*: Loba—; *Jodhpur*: Bapji—; *Jukun*: Afyinu, Shinu—; *Kanuri*: Kabur—; *Kaolak*: Guguniece—; *Koranko*: Sogoi—; *Krobo*: Danwe—; *Lagos*: Efirin nlą, Efirin oshu—; *Limba*: Fufurufuru—; *Madagascar*: Kiranjay—; *Malay*: Kemangi—; *Malayalam*: Katturamatulasi—; *Malinke*: Su-kola—; *Mandingo*: Sisejambo—; *Manja*: Sâhagna—; *Mbi*: Gouroulou—; *Moorish*: Gumuguei—; *Old Calabar*: Iyino—; *Oloke Meji*: Efinrin marag-bosanyan—; *Persian*: Badrudge ibieze, Reyhane kuhi, Tukhm-chirbati—; *Porto Rico*: Abahaca cimarrona—; *Sadani*: Garaighasi—; *Sango*: Tété—, *Sanskrit*: Ajaka, Arjaka, Gambhira, Gandhapanirjjaka, Jambira, Kathinjara, Kshudraparna, Kshudratulasi, Kuthera, Mukharjaka, Ugagàndha—; *Santali*: Bharbhari—; *Sierra Leone*: Patnage—; *Sinhalese*: Hintalla—; *Spanish*:

Albahaca—; *Suto*: Mmavwatwane—; *Tamil*: Ganjamkorai, Kanjankorai, Naitulasi—; *Telugu*: Kukkatulasi—; *Timne*: An-soro, E-soro, Koe suru—; *Tivi*: Kungulaku—; *Togbo*: Biroulou—; *Twi*: Emeng—; *Woloff*: Ngumgume—; *Yoruba*: Aruntantan, Efinrin aja, Efinrin ata, Efinrin marugboshanyan, Efinrin wewe—.

3. **Ocimum gratissimum** Linn. is found throughout India and Ceylon, often cultivated. It is distributed to Java, tropical Africa and America.

Aromatic baths or fumigations prepared with the plant are advised in the treatment of rheumatism and paralysis. In the aphthae of children a strong decoction has been found effectual.

A decoction of the leaves is of value in cases of seminal weakness, and is an esteemed remedy in gonorrhoea.

The seeds are given in headaches and neuralgia.

In China the leaves and flowers are used as a sudorific in diseases of the lungs.

Considered digestive and pectoral in La Reunion. On the Gold Coast the leaves are mashed and used as an enema by newly delivered women. It is also used for young infants.

A very popular remedy in Madagascar. It is considered aromatic, digestive, tonic, pectoral, antiemetic, antispasmodic, antineuralgic, The Betsileo chew the leaves for toothache, and sniff the juice of the leaves or the powdered seeds in headache.

Arabic: Furanjmishk—; *Bengal*: Ramtulshi, Ramtulsi—; *Betsileo*: Romba—; *Bombay*: Ramatulasa, Rantulsi, Tulsi—; *Chinese*: Tzeu Sou—; *Deccan*: Ramtulsi—; *English*: Large Basil, Lemon Basil, Shrubby Basil—; *Ewe*: Daiblorsi—; *French*: Basilic *crépu*—; *Gujerati*: Avachibavachi, Ramtulasi—; *Hindi*: Bantulsi, Malatulsi, Ramtulsi—; *La Reunion*: Baumier, Gros braume—; *Malay*: Ruku-ruku hitam, Selaseh besar—; *Malayalam*: Kattutrittavu, Ramatulasi—; *Marathi*: Ramatulasi, Ranatulasu—; *Mauritius*: Basilic, Toulashi, Toulsi—; *Mundari*: Dimbubaha—; *Persian*: Palangmishk—; *Porebunder*: Ramtulasi—; *Punjab*: Banjere—; *Sadani*: Dimbu—; *Sanskrit*: Ajaka, Doshakleshi, Nidralu, Ramatulasi, Shophahari, Sugandhi, Sukshmapatraka, Sumukha, Suprassanaka, Suvakra, Vanabarbarika, Vishaghna, Vriddhatulasi—; *Sinhalese*: Gastala, Kiritala, Otala—; *Tamil*: Elumichantulasi, Peruntulasi, Ramtulasi—; *Tankay*: Romba—; *Telugu*: Nimmatulasi, Ramatulasi—; *Urdu*: Ramtulasi—; *Uriya*: Ramotulosi, Sondabhogohulono—; *Visayan*: Coloncogon—; *Yemen*: Hobokbok, Shajaret eszir, Vusab—.

4. **Ocimum sanctum** Linn. is found throughout India, Burma, and Ceylon, and distributed to the Malay Archipelago, Australia, the islands of the Pacific, Western Asia, and Arabia.

The root is given in decoction as a diaphoretic in malarial fevers.

The leaves have expectorant properties, and their juice is used in catarrh and bronchitis. This preparation also is applied to the skin in ring-worm and other cutaneous diseases. An infusion of the leaves is used as a stomachic in the gastric disorders of children, and in hepatic affections. The dried leaves are powdered and employed as a snuff in ozaena. They are also an effectual means of dislodging maggots. The juice dropped into the ear is said to be a good remedy for earache.

The leaves are a South Indian substitute for tea. In the Tamil country the flower-tops are ground with sesamum oil and given internally to help the expulsion of the foetus.

In Arabia the leaves are given together with pepper in tertian and quartan fevers.

The seeds are mucilaginous and demulcent, and are given in disorders of the genito-urinary system.

In Ceylon the herb is used in decoctions for cough and catarrh, sometimes chewed as a substitute for betel.

The fresh roots are ground with water and applied to the stings of wasps and bees and the bites of worms and leeches. The bruised fresh roots, stems, and leaves are applied to the bites of mosquitoes (Roberts).

Every part of the plant finds its application in the treatment of snake-bite and scorpion sting; but Caius and Mhaskar have shown experimentally that every part of it is equally useless in the antidotal and symptomatic treatment of snake-bite and scorpion sting.

The juice of the leaves or decoction of the same is considered to possess diaphoretic, antiperiodic and stimulating expectorant properties. A compound decoction of *O. sanctum, Tinospora cordifolia,* and *Evolvulus alsinoides* was given in cases of malarial fever with no benefit (Koman).

Arabic: Dohsch, Schadjant eszirr, Vusab—; *Badaga*: Kapputulasi—; *Bengal*: Kalatulsi, Kural, Tulshi, Tulsi—; *Bombay*: Tulas, Tulasa—; *Burma*: Lun—; *Canarese*: Kalatulasi, Karitulasi, Sritulasi, Tulasi—; *Deccan*: Tulsi—; *English*: Holy Basil, Monk's Basil, Rough Basil, Sacred Basil—; *Gujerati*: Talasi—; *Hindi*: Baranda, Kalatulsi, Krishnatulsi, Tulsi, Varanda—; *Ilocano*: Biday—; *Konkani*: Tulsi—; *Malay*: Oku, Ruku-ruku merah, Selaseh hitam—; *Malayalam*: Krishnatulasi, Kunnakam, Nallatrittavu, Punya, Sivatulasi, Surasam, Trittavu, Tulasi—; *Marathi*: Tulasa, Tulasichajadha—; *Pampangan*: Locoloco—; *Philippines*: Albahaca—; *Portuguese*: Mangericao—; *Punjab*: Bantulsi, Tulsi—; *Queensland*: Bulla-bulla, Mooda—; *Sanskrit*: Ajaka, Arjaka, Amrita, Apetarakshasi, Bahupatri, Bharati, Bhutaghni, Bhutaka, Bhutapatri, Brinda, Devadundubhi, Divya, Gandhaharini, Gauri, Gramya, Haripriya, Kathinjara, Kayastha, Krishnamula, Krishnatulasi, Kutheraka, Laxmi, Madhavi, Malashreshtha, Manjari, Papaghni, Parnasa, Patrapushpa, Pavani, Pavitra, Pretarakshasi, Punya, Sarasa, Shrikrishnavallabha, Shyama, Subhaga, Sugandha, Sulabha, Surabhi, Suradundubhi, Surasa, Suravallari, Suravalli, Surejya, Suvaha, Tivra, Tridashamanjari, Tulasi, Vaishnavi, Vishnupatni, Vishnuvallabha, Vrinda—; *Sinhalese*: Madurutala, Mudurutulla—; *Spanish*: Albahaca morada—; *Tagalog*: Balanoi, Locoloco—; *Tamil*: Alangai, Karuttulasi, Kulimittan, Kullai, Kumuli, Malgodai, Malmurugu, Mudi, Nediyon, Pirundam, Sirttulay, Surasa, Surasam, Suriyagarandai, Savadugundi, Suvi, Tulasi, Tulavam, Tulay—; *Telugu*: Brynda, Gaggera, Krishnatulasi, Kukkatulasi, Nallagaggera, Nallatulasi, Tellatulasi, Tulasi—.

Origanum.

The genus consists of 7 species, natives of the Mediterranean region.

O. dictamnus Linn., *O. hirtum* Link., *O. Majorana* Linn., *O. virens* Hoff. and Link, *O. vulgare* Linn. are used medicinally in Europe; *O. vulgare* Linn. is also used in China and Malaya.

1. The 2 longest stamens and sometimes all 4 projecting beyond the corolla ... ... *O. Majorana.*
2. Stamens 4 in unequal pairs slightly protruding ... *O. vulgare.*

1. **Origanum Majorana** Linn., a native of Europe, North Africa and Asia Minor, is extensively cultivated in India.

The herb is carminative and stomachic; useful in measles.

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The leaves and seeds are considered astringent and a remedy for colic. The essential oil from the leaves is used for hot fomentations in acute diarrhoea.

In Europe an infusion made from the fresh plant is given to relieve nervous headaches; and externally the herb is applied in bags as a hot fomentation to painful swellings and rheumatism, as likewise for colic. The volatile oil is considered an excellent external application for sprains, bruises, etc.

Arabic: Mardakusch, Merdkouche, Mizunjush—; *Bogotá*: Mejorana—; *Bengal*: Murru—; *Catalan*: Moraduix, Moradux—; *Deccan*: Murwa—; *Dutch*: Marjolein—; *Egypt*: Bardaquesh, Mardaqush—; *English*: Sweet-knotted Marjoram, Sweet Marjoram—; *French*: Marjolaine à coquille, Marjolaine des jardins, Marjolaine d'Orient, Origan marjolaine—; *German*: Badkraut, Blaudoste, Blauer Tarant, Blaudunst, Costenzkraut, Doschte, Dost, Felddoste, Frauendosten, Kostenskraut, Kunerle, Kuttelkraut, Majoran, Maraun, Margrankraut, Marieleine, Masaran, Maseran, Masoran, Meiran, Meyran, Muellerkraut, Ohrkraut, Schusterkraut, Sommermajoram, Thorant, Walddosten, Wohlgemut, Wurstkraut—; *Greek*: Amarakon, Masuran—; *Hindi*: Murwa—; *Italian*: Maggiorana, Marjorana, Persa—; *Kumaon*: Bantulsi—; *Languedoc*: Majourana, Majourena, Majurena, Mayran—; *Malta*: Sweet Marjoram, Maggiorana, Persia, Mertkux—; *North America*: Knotted Marjoram, Marjoram, Sweet Marjoram—; *Roumanian*: Maghiran—; *Russian*: Mayoran—; *Sanskrit*: Ajanmasurabhipatra, Bahuvirya, Gandhapatra, Jambira, Kharapatra, Kulasaurabha, Maricha, Maru, Marubaka, Maruta, Marutaka, Phani, Phanijjaka, Prasthakusuma, Prasthapushpa, Samirana, Shitalaka, Suravha—; *Sind*: Murwo—; *Spanish*: Almoradux, Mejorana—; *Tamil*: Marru—; *Urdu*: Marvakhusha—; *Yemen*: Mardakush—.

2. **Origanum vulgare** Linn. occurs plentifully in the Himalaya, from Kashmir to Sikkim, between altitudes of 7,000 and 12,000 feet. It is distributed to Europe, North Africa, western and northern Asia.

The herb is carminative, anodyne, stomachic, and emmenagogue. In China it is considered an excellent refrigerant.

Externally, the dried leaves and flower-tops may be applied in bags as a hot fomentation to painful swellings and rheumatism, as well as for colic. An infusion made from the fresh plant will relieve nervous headache.

The whole herb is medicinal and contains a volatile oil, which is separated by distillation. Perspiration may be produced by a warm infusion, and this is useful in the commencement of measles to bring out the eruption; it is also taken to promote the menstrual flow, when suppressed by cold; it is also valuable in spasms, colic, and to give relief from pain in dyspeptic complaints.

The oil is stimulant and rubefacient, and often used as a liniment; it is given as a stimulant and tonic in colic, diarrhoea, and hysteria. It is also applied in chronic rheumatism, tooth-ache, and ear-ache.

Arabic: Buklutulgezal, Mirzanjosha, Sutur—; *Bohemian*: Dobramyssl—; *Catalan*: Orenga—; *Chinese*: Ching Chieh, Yin Ch'en—; *Danish*: Tost, Vild merian—; *Dutch*: Orego—; *English*: Common Marjoram, Organ, Organy, Origany, Wild Marjoram—; *French*: Grande marjolaine, Grande marjolaine bâtarde, Grande marjolaine sauvage, Grand origan, Marjolaine d'Angleterre, Marjolaine bâtarde, Marjolaine sauvage, Pied de lit, Origan, Origan commun, Origan vulgaire—; *German*: Blauer Orant, Brauner Dosten, Dosten, Wilder Majoran—; *Greek*: Origanos—; *Hindi*: Mirzanjosh, Sathra—; *Italian*: Origano,

Regano—; *Malaya*: Yan chan—; *Malta*: Common Marjoram, Pot Marjoram, Regamo, Acciughero, Riegnu—; *Marathi*: Marvā, Mayarona—; *North America*: Common Marjoram, Origanum, Pot Marjoram, Wild Marjoram, Winter Marjoram, Winter-sweet—; *Norwegian*: Vild merican—; *Persian*: Mizangosch, Mirzanjosha, Oushneh—; *Polish*: Lebiotka—; *Portuguese*: Ouregao, Ouregos—; *Punjab*: Mirzanjosh—; *Russian*: Dushitsa—; *Spanish*: Oregano—; *Swedish*: Dosta—; *Telugu*: Mridumaruvamu—; *Urdu*: Mirzanjosha—.

Orthosiphon.

The genus includes 50 species, natives of Indo-Malaya and tropical Africa.

Orthosiphon stamineus Benth. occurs in Assam, Burma, the Nicobar Islands, and South India. It is distributed to the Malay Archipelago, the Philippine Islands, and Australia.

In Java the leaves are made into a tea, and used in the treatment of diseases of the kidneys and bladder. They are official in Holland.

English: Cat's Whiskers, Java Tea—; *French*: Barbiflore, Thé de Java—; *Malay Archipelago*: Koemis Koetjing, Remock djoeng—.

Otostegia.

The genus consists of 10 species, inhabitants of Western Asia and Abyssinia.

1. Leaves spine-tipped; calyx naked within ... *O. Aucheri*,
2. Leaves not spine-tipped; calyx bearded within ... *O. limbata*.

1. **Otostegia Aucheri** Boiss. occurs in Baluchistan, whence it spreads to southern Persia.

At Kohlu in Baluchistan the drug is administered in suppressed small-pox if the pox do not appear, after which the pox appear (Hughes-Buller).

Baluchi: Samar, Shinisg—; *Brahui*: Sadikh, Samar—; *Kohlu*: Suraghzai—.

2. **Otostegia limbata** Hook. fil. is found on the lower hills of the Punjab, west of the Jhelum to the Salt Range.

The juice of the leaves is applied to children's gums, and to ophthalmia in man and beast (Stewart).

Hazara: Chitiboi—; *Punjab*: Agzhan, Awanibuti, Bui, Jandi, Kandiari, Lana, Phutkanda—.

Perilla.

The genus consists of 3 species, spreading from India to Japan.

Perilla ocimoides Linn. is found from Kashmir to Bhotan at altitudes of 1,000 to 10,000 feet; also in the Khasia Mountains from 3,000 to 6,000 feet; it is cultivated in Chittagong; from Champaran it extends to Burma, and is distributed to Indo-China, China, and Japan.

In China and Indo-China the leaves, the stems and the seeds are considered resolvent, diaphoretic, and cephalic. They are

prescribed in cephalalgia, hypochondriasis and mania. The leaves are eaten raw or cooked, or administered as an infusion; the seeds are either toasted or dispensed in the form of a decoction.

The plant is a popular remedy in Annam, where it is used as a sedative, an antispasmodic, and an antidote. At Vinh the herb, without the roots, is made into a decoction and taken on an empty stomach for sunstroke. At Nghe-an the decoction is used as a uterine stimulant. At Nam-o it is combined with an equal amount of *Ocimum sp.*, and used as a fumigant.

Annam: Bach to, Rau hung, Thai am mau, Tu to, Xich to—; *Chinese*: Sou Yeh—; *Hindi*: Bhanjira—; *Kumaon*: Bhangara, Jhutela—; *Naga*: Kenia—; *Vinh*: Tia to, Tu to—.

Perowskia.

The genus consists of 4 species, natives of Central Asia.

1. Leaves linear-oblong, incised or pinnatisect. Calyx closed with long cottony wool ... ... *P. abrotanoides*.
2. Leaves oblong-ovate or lanceolate, crenate-serrate or incised. Calyx hispid ... ... *P. atriplicifolia*.

1. **Perowskia abrotanoides** Karel. is met with in the Western Himalaya at altitudes of 8,000 to 13,000 feet, and in Baluchistan; it is distributed to Afghanistan, Persia, and Turkestan.

At Ziarat the plant is used as a cooling medicine. The flowers are soaked in water; and this is very cooling when applied to the body of a patient suffering from fever.

Brahui: Gwari drani—; *Pushtu*: Shanshohai—; *Seistan*: Maur—.

2. **Perowskia atriplicifolia** Benth. occurs in Kashmir at 7,500-10,000 feet, and in Baluchistan, whence it spreads to Afghanistan.

In Baluchistan the plant is used as a cooling medicine.

Baluchistan: Gwaree dumoo, Gwaridrane, Tirk—; *Waziristan*: Sansobe—.

Platystoma.

The genus consists of 4 species, natives of tropical Asia and Africa.

Platystoma africanum Beauv. occurs in Bombay, Dharwar, North Kanara, and Mysore. It inhabits tropical Africa.

In Northern Nigeria it is used for fever, feverish chills or rheumatic symptoms. In Gold Coast the leaves and seeds are a remedy for children's coughs, and are also chewed with salt to cure sore throat. The juice is squeezed into the eyes to cure headache and fever. The leaves are used in Southern Nigeria as a local haemostatic.

Ashanti: Asiresidie, Saman meng—; *Benin*: Eborukhu—; *Ewe*: Sesebli—; *Hausa*: Kimbar-rafi—; *Nzima*: Siresireke—; *Twi*: Asirisiri—.

Pogostemon.

The genus consists of 36 Indomalayan species.

A. Bracts ovate, imbricating, more or less concealing the calyx.

1. Stems and leaves nearly glabrous. Flowers purple ... *P. parviflorus.*
2. Stems and leaves below hoary-puberalous. Flowers pink or white ... ... *P. plectranthoides.*

B. Bracts narrow, lanceolate, not imbricating, not concealing the calyx.

1. Spikes more or less continuous, about 1 cm. broad ... *P. purpurascens.*
2. Spikes much interrupted, 5-6 mm. broad ... ... *P. Heyneanus.*

1. **Pogostemon Heyneanus** Benth. (= *P. Patchouli* Hook. fil.) occurs in Kanara, the Western Ghats, and the Nilgiris. It extends to Ceylon, and is distributed to Java and the Philippine Islands.

The plant is diuretic, carminative, and insecticide. It yields an essential oil largely employed in perfumery.

Bengal : Pachapat— ; *Bombay* : Patchpan— ; *Dutch* : Patchoeli— ; *English* : Patchouli— ; *French* : Patchouli— ; *Gujerati* : Patchpanadi— ; *Hindi* : Pacholi, Peholi— ; *Malaya* : Bur kalif, Poko nilam— ; *Marathi* : Mañ, Patcha, Patchpan— ; *Sind* : Panel— ; *Sinhalese* : Gang-kolang-kola— ; *Spanish* : Pachuli— ; *Straits Settlements* : Tilam wangi— ; *Visayan* : Cablan—.

2. **Pogostemon parviflorus** Benth. occurs more or less throughout India.

The fresh leaves, bruised, are applied as a cataplasm in order to clean wounds and promote healthy granulation. In Satara the juice is given in colic and fever.

The root is a reputed remedy for haemorrhage, and has been given successfully in uterine haemorrhage.

The roots are used in the Ratnagiri District as an antidote for the poison of *Echis carinata*, a common snake in that district. The plant, in combination with other drugs, is prescribed as an antidote to snake and scorpion venoms; but Caius and Mhaskar have shown experimentally that no part of the plant is an antidote to either snake or scorpion venom.

Bombay : Pangla, Phang, Phangla— ; *Konkani* : Pangla— ; *Marathi* : Pangli— ; *Matheran* : Pangli—.

3. **Pogostemon plectranthoides** Desf. is found in the Western Himalaya, Lower Bengal and Upper Burma, Bihar, Gujerat, Konkan, and South India.

The properties are said to be the same as those of *P. parviflorus.*

Bengal : Jin— ; *Deccan* : Pangla— ; *Garhwal* : Lujra— ; *Khond* : Ishwarjata— ; *Konkani* : Pangla— ; *Haldwani* : Kalabasinga— ; *Ramnagar* : Rudera— ; *Telugu* : Kusurijang— ; *Uriya* : Dumobadotoko, Gondripulu, Poksunga—.

4. **Pogostemon purpurascens** Dalz. is found in South India, Manipur, and Burma.

It is used as a substitute for *P. parviflorus.*

ROYLEA.

Roylea elegans Wall., the only species, is found in the subtropical Western Himalaya from Kashmir to Kumaon, at altitudes between 2,000 and 5,000 feet.

An infusion of the leaves is drunk for contusions produced by blows, and about Kumaon the same preparation is used as a bitter tonic and febrifuge.

Garhwal: Karui, Titpati—; *Hindi*: Patkarru—; *Jaunsar*: Karanoi—; *Kumaon*: Kauri, Titpatti—; *Punjab*: Kaur, Kauri—.

SALVIA.

The genus numbers 550 species, inhabiting the tropical and temperate regions of the world.

The following species are used medicinally in Europe—*S. aethiopis* Linn., *S. canariensis* Linn., *S. glutinosa* Linn., *S. Grahami* Benth., *S. hispanica* Linn., *S. Horminum* Linn., *S. officinalis* Linn., *S. pratensis* Linn., *S. Sclarea* Linn., *S. triloba* Linn. fil., *S. Verbenaca* Linn., *S. verticillata* Linn., *S. viridis* Linn.—; in China—*S. japonica* Thunb., *S. miltiorhiza* Bunge., *S. plebeja* R. Br.—; in Malaya—*S. miltiorhiza* Bunge—; in North America—*S. lanceolata* Bruce, *S. officinalis* Linn., *S. Verbenaca* Linn.—; Mexico—*S. polystachya* Ort., *S. hispanica* Linn.—; in Colombo—*S. palaefolia* H. B. K.—; in Madagascar—*S. leucodermis* Bak.—; in La Reunion—*S. gerardiana* Benth.—; in Mauritius—*S. coccinea* Juss.—; in South Africa—*S. africana* Linn., *S. aurea* Linn., *S. coccinea* Juss., *S. paniculata* Linn., *S. repens* Burch., *S. rugosa* Thunb., *S. runcinata* Linn. fil., *S. scabra* Thunb., *S. sisymbrifolia* Skan., *S. stenophylla* Burch., *S. triangularis*. Thunb.—.

I. Small shrubs or undershrubs; leaf-blade usually .5-2 cm. long
- 1. Corolla 15-25 mm. long ... ... *S. cabulica.*
- 2. Corolla 5 mm. long ... ... *S. aegyptiaca.*

II. Herbs; leaf-blades usually much exceeding 2 cm.
- A. Leaves more or less thick, rugose or rugulose; calyx teeth more or less spinous.
  - 1. All leaves more or less sessile, oblanceolate ... *S. lanata.*
  - 2. All or lower leaves petiolate, ovate to oblong.
    - a. Calyx 20-25 mm. long, in fruit.
      - i. Leaves subentire or serrate; bracts usually whitish ... ... *S. macrosiphon.*
      - ii. Leaves coarsely dentate or lobed; bracts usually green ... ... *S. spinosa.*
    - b. Calyx 10-15 mm. in fruit. Perennial ... *S. Moorcroftiana.*
- B. Leaves membranous, neither rugose nor rugulose; calyx teeth not spinous.
  - 1. Corolla 5 mm. long, white or lilac. Annual ... *S. plebeia.*
  - 2. Corolla 25-30 mm. long, yellow ... ... *S. glutinosa.*

1. **Salvia aegyptiaca** Linn. occurs in the Punjab plains, Sind, and Baluchistan, whence it spreads westwards to Afghanistan. It is distributed to Persia and North Africa.

At Pab, in Jhalawan, the plant is used as a cure for eye diseases.
In Sind the seeds are used as demulcent in diarrhoea, gonorrhoea, and haemorrhoids.

Arabic: Ra 'al, Raale, Sadjaret el ghasal, Shajaret-el-ghazal—; *Baluchi*: Kohi maur—; *Bolan*: Chamimar, Chammamaor—; *Egypt*: Ra 'al, Shegeret-el-ghazal—; *Pab*: Maur—; *Punjab*: Tukhmmalanga—; *Tank*: Paska, Rangboti—.

2. **Salvia cabulica** Benth. extends from the Punjab frontier to Baluchistan and Afghanistan.

In Baluchistan the plant is considered a cure for fever, also for colds and lung diseases.

Baluchistan: Mateto—.

3. **Salvia glutinosa** Linn. occurs in the North-West Frontier Province, Kashmir. the Punjab, Kumaon, Gharwal, Sikkim, and Bhootan. It is distributed to Tibet, Western Asia, and Europe.

In some parts of Europe an infusion of the leaves and flower tops is used as a diaphoretic, stimulant, and stomachic. It is an excellent lotion for ulcers, and to heal raw abrasions of the skin.

Spanish: Cetro de Júpiter—.

4. **Salvia lanata** Roxb. is found in the Western Himalaya, from Murree to Kumaon, at altitudes of 5,000 to 8,000 feet.

'It is a good substitute for *S. Moorcroftiana.*

5. **Salvia macrosiphon** Boiss. extends from the Punjab frontier to Baluchistan, Afghanistan and Persia.

At Pre Ghal, in Waziristan, the plant is used as a poultice for gangrene.

6. **Salvia Moorcroftiana** Wall. is found in the Western Himalaya, from Kashmir to Kumaon, at altitudes of 6,000 to 9,000 feet.

The root is given in cough, and the seeds are used as an emetic. The leaves are a medicine for guinea-worm and itch, and in the form of poultice applied to wounds. At Lahore, the seeds are given in colic and dysentery, and are applied to boils. The seeds are given for haemorrhoids.

Punjab: Gurgumma, Halu, Kallijarri, Laphra, Papra, Shobri, Thut—.

7. **Salvia plebeia** R. Br. is found throughout India. It is distributed to China, the Malay Islands and Australia.

The seeds are used as demulcent in gonorrhoea, menorrhagia, diarrhoea, and haemorrhoids.

The herb is used as a diuretic, astringent, and anthelmintic in China.

Bengal: Bhutulsi, Khokaburadi—; *Bombay*: Kammarkas—; *Chinese*: Ching Chieh, Ho Shih—; *Punjab*: Samundarsok, Sathi—; *Sind*: Kiuro, Summundursok—.

8. **Salvia spinosa** Linn. occurs in Baluchistan, and is distributed to Mesopotamia, Syria, and Arabia.

At Burj, in Toba Achakzai, the seed is powdered and applied to the teeth to cure tooth-ache.

Egypt: Na'eyme, Shadjeret-el-gemal, Ta'elbe, Tha'alaba—; *Mosul*: Hamham—; *Pushtu*: Ganacha—; *Quetta-Pishin*: Ganacha—.

SATUREIA.

The genus numbers 130 species dispersed through the warm regions of the world.

S. hortensis Linn., *S. montana* Linn., and *S. Thymbra* Linn. are used medicinally in Europe.

Satureia hortensis Linn. occurs in Kashmir. It is distributed to Afghanistan, Western Asia, Europe, America, and South Africa.

The herb is aromatic and carminative. The leaves and flower-tops are used as a stimulant.

Catalan: Sajulida, Sajurida—; *Dutch*: Boonenkruid—; *English*: Summer Savory—; *French*: Herbe de Saint Julien, Sadrée, Sarriète, Sarriette, Sarriette des jardins, Sauriette, Savorée, Savourée—; *German*: Bohnenkraut—; *Italian*: Santoreggia, Satureja—; *Portuguese*: Segurelha—; *Roumanian*: Galbinare—; *Russian*: Chaber—; *Spanish*: Ajedrea, Tomillo real—.

SCUTELLARIA.

The genus includes 200 cosmopolitan species.

S. canescens Nutt., *S. cordifolia* Muehl., *S. galericulata* Linn., *S. integrifolia* Linn., *S. lateriflora* have, at some time or other, been used medicinally and also as a source of 'scutelarin'—; *S. baicalensis* Georg. is used in China.

Scutellaria galericulata Linn. is found in Kashmir. It inhabits Central and Northern Asia, Europe, North Africa, and North America.

If a decoction of the plant is made with 2 ounces of the herb to 8 ounces of water, and is taken for some weeks continuously in recent epilepsy, or when the disease has only functional causes, it will often prove very beneficial. Likewise, this decoction, in common with an extract of the herb, has been given curatively for intermittent fever and ague, as well as for some depressed and disordered states of the nervous system.

A homoeopathic tincture has been successfully given in cases of the epileptiform 'petit mal'.

The crushed plant is applied fresh to old ulcers.

The Flambeau Ojibwe, of North America, use the plant for medicine having something to do with heart trouble.

Dutch: Glidkruid—; *English*: Blue Scullcap, Greater Scullcap, Helmet Flower, Hooded Willow Herb, Hoodwort—; *Flambeau Ojibwe*: Tcatcabonû 'ksik—; *French*: Grande toque, Scutellaire en toque, Toque—; *German*: Helmkraut, Stumpfhelmkraut—; *North America*: Hooded Scullcap, Marsh Skullcap—; *Spanish*: Escutelaria—.

Stachys.

The genus consists of 200 cosmopolitan species, absent from Australia.

The following species are used medicinally in Europe—*S. annua* Linn., *S. arvensis* Linn., *S. Betonica* Linn., *S. germanica* Linn., *S. hirta* Linn., *S. maritima* Linn., *S. palustris* Linn., *S. recta* Linn., *S. sylvatica* Linn.—; in China—*S. aspera* Michx., *S. Sieboldi* Miq.—; in Colombia—*S. bogotensis* H. B. K.—.

I. Stems and leaves beneath densely white woolly ... *S. parviflora.*

II. Stems and leaves densely or sparingly hairy, but not woolly.
1. Leaves petioled; corolla-tube exserted.
   a. Petiole 2 cm. or shorter, margin crenate ... *S. Sieboldi.*
   b. Petiole 4 cm. or longer, margin serrate ... *S. sylvatica.*
2. Leaves sessile; corolla-tube included ... ... *S. palustris.*

1. **Stachys palustris** Linn. grows in Kashmir. It is found in Northern and Western Asia, Europe, and North America.

The plant has always had in Europe a great reputation as a vulnerary.

In modern herbal medicine the herb, collected when just coming into flower and dried, is employed for its antiseptic and antispasmodic properties. It relieves gout, cramp and pains in the joints, and vertigo. The bruised leaves when applied to a wound will stop bleeding and heal the wound. The fresh juice is made into a syrup and taken internally to stop haemorrhages, diarrhoea, and dysentery.

In North America the plant is used as a vulnerary, antispasmodic, emetic, and emmenagogue.

English: All-Heal, Clown's Woundwort, Downy Woundwort, Husbandman's Woundwort, March Woundwort, Marsh Woundwort, Opopanewort, Panaij—; *French*: Crapaudine, Epiaire des marais, Ortie morte, Ortie rouge, Stachys des marais—; *North America*: Clown's All-heal, Clown's Woundwort, Dead-nettle, Hedge-nettle, Marsh Woundwort, Rough-weed—.

2. **Stachys parviflora** Benth. is found in the Punjab plains and hills; it extends to Afghanistan.

In the Salt Range the bruised stems are applied to the guinea-worm.

Punjab: Baggibuti, Kirimar—; *Pushtu*: Speraghunai—.

3. **Stachys Sieboldi** Miq. occurs in Upper Burma; it extends to China.

The plant is used medicinally in China as a febrifuge, astringent, and vulnerary.

Chinese: Ts'ao Shih Ts'an—.

4. **Stachys sylvatica** Linn. is found in Kashmir; it extends to Northern Asia and Europe.

An old authority has it that this herb 'stamped with vinegar and applied in manner of a pultis, taketh away wens and hard

swellings, and inflammation of the kernels under the eares and jawes', and also that the distilled water of the flowers 'is used to make the heart merry, to make a good colour in the face, and to make the vital spirits more fresh and lively'.

The plant is credited in France with tonic, emmenagogue, and diuretic properties.

English : Hedge Woundwort—; *French* : Epiaire des bois, Ortie à crapaud, Ortie morte des bois, Ortie puante, Stachys des bois—.

Teucrium.

The genus includes 100 cosmopolitan species.

The following species are used medicinally in Europe—*T. Botrys* Linn., *T. Chamaedrys* Linn., *T. fruticans* Linn., *T. majorana* Pers., *T. marum* Linn., *T. montanum* Linn., *T. Polium* Linn., *T. pyrenaicum* Linn., *T. scordium* Linn., *T. scorodonia* Linn.—; in South Africa—*T. capense* Thunb., *T. riparium* Hochst.—.

1. Leaves small, subsessile, ovate or obovate, cuneate-attenuated, obtuse ... ... *T. Stocksianum.*
2. Leaves small, sessile, oblong, obtuse ... ... *T. scordium.*

1. **Teucrium scordium** Linn. is found in Kashmir; it extends to Afghanistan, Northern and Western Asia, Europe, and North Africa.

The herb is considered in Europe antiseptic, diaphoretic, and stimulant. An infusion gives excellent results in all inflammatory diseases.

In Spain the flower tops and the leaves are considered aromatic, bitter, astringent, and are mostly used as diaphoretics and vermifuges.

Arabic : Skordeon—; *Bohemian* : Wodnj czessner—; *Catalan* : Escordi—; *Danish* : Skordium—; *Dutch* : Waterlook—; *English* : Water Germander—; *French* : Germandrée aquatique, Germandrée d'eau, Scordium—; *German* : Batengel, Knoblauch gamander, Lachenknoblauch, Lachinsknopfloch, Laeusekraut, Moosknoblauch, Peterskraut, Rosslauch, Schlagkraut, Schorseken, Scordienkraut, Sonnenschiit, Wasserbathengel, Wasserknoblauch—; *Greek* : Scordion, Scordochorto—; *Hungarian* : Vizi foghadyma—; *Italian* : Scordio—; *Lithuanian* : Embutti—; *Polish* : Czosnkowc ziele—; *Portuguese* : Escordio—; *Russian* : Dikiy tchesnok, Scordiya, Zayatchiy tchesnok—; *Spanish* : Escordio, Escordio oficinal—.

2. **Teucrium Stocksianum** Boiss. occurs in the Western Punjab, the North-Western Frontier Province, Baluchistan, and Afghanistan.

In the Harboi Hills the herb is given in cases of pain at the heart. At Kirani, near Quetta, it is used as a cure for fever.

In Persian Baluchistan the plant is boiled and allowed to stand all night; the water is then drunk as a remedy for colds.

Baluchistan : Kalpora, Kalporag—; *Waziristan* : Kastorai—.

Thymus.

The genus consists of 33 species, inhabiting the temperate regions of the world.

T. mastichina Linn., *T. serpyllum* Linn., and *T. vulgaris* are used medicinally in Europe.

Thymus serpyllum Linn. is found in the Western temperate Himalaya, from Kashmir to Kumaon, at altitudes between 5,000 and 13,000 feet. It is distributed to Northern and Western Asia, Europe, and North Africa.

In the Punjab the herb is given in weak vision, complaints of the stomach and the liver, suppression of urine and menstruation (Honigberger). On the Chenab the seeds are given as a vermifuge (Stewart).

The oil is sometimes applied as a remedy in toothache.

In Europe the herb is considered antispasmodic, carminative, and tonic. An infusion is given in convulsive coughs, whooping coughs, catarrh, and sore throat; it is good for nervous or hysterical headaches, for flatulence, and the headache which follows inebriation. The infusion is also profitably applied for healing skin eruptions of various characters.

In Persia the leaves are considered carminative. In Teheran they are given for 'too much water in the stomach'.

Arabic : Saatar— ; *Catalan* : Farigola de montanya, Serpoll— ; *Danish* : Vildtimian— ; *Dutch* : Quendel, Wilde Thym— ; *English* : Bank Thyme, Brotherwort, Creeping Thyme, Hill-wort, Horse Thyme, Mother of Thyme, Pella Mountain, Penny Mountain, Piliol, Puliali Mountain, Running Thyme, Serpell, Shepherd's Wild Thyme, Wild English Thyme, Wild Thyme— ; *French* : Mignotise des Génevoix, Pillolet, Piolet, Poleur, Pote, Pouilleux, Pouliet, Pouliot bâtard, Serpolet, Serpoule, Thym bâtard, Thym rouge, Thym sauvage, Thym serpolet— ; *German* : Ameisenkraut, Bienenkraut, Choelm, Citronenquendel, Demutkraut, Fallboll, Feldkoehm, Feldkuemmel, Feldquendel, Feldthymian, Gundelkraut, Gundling, Gunnerle, Heidequendel, Heublume, Huehnerklee, Huehnerkull, Immenkraut, Jungfernzucht, Kandelkraut, Karwendel, Kindelkraut, Kingle, Koschmes, Kostenskraut, Kudelkraut, Kuechenpolei, Kuekenkuemmel, Kuenlein, Kulkraut, Kundelkraut, Kunerle, Kutelkraut Magaro, Marienbettstroh, Mattenkolen, Neugelenk, Quandel, Quangelchen, Quendel, Quengel, Raenderpolei, Rainkuemmel, Rainpolei, Schmergel, Simio, Steinquendel, Thymchen, Thyrmann, Tuemchen, Unsererlieben-frauenbettstroh, Zymis— ; *Greek* : Erpylos— ; *Hindi* : Banajwain— ; *Italian* : Pepolino, Sermollino, Serpillo, Serpolino, Serpollo— ; *Languedoc* : Faligouleto, Ferigouleto— ; *North-Western Provinces* : Banajwain— ; *Persia* : Djusha, Seetere, Zatar— ; *Polish* : Mauerzanka— ; *Portuguese* : Serpao, Serpil, Serpilhi, Serpol— ; *Punjab* : Kalandarzatar, Marizha, Masho, Rangsbur, Shakei— ; *Roumanian* : Cimbru de camp, Cimbrusor, Serpun, Serpunel— ; *Russian* : Bogorodskaya trava, Chaber, Chabietz— ; *Spanish* : Serpol— ; *Swedish* : Backtimjan, Bracktimian— ; *Teheran* : Joshan shirazi— ; *Turkish* : Sateriberri— ; *Urdu* : Hasha— ; *Yemen* : Saatar—.

ZATARIA.

Zataria multiflora Boiss. is found in Baluchistan, whence it spreads to Afghanistan and Persia.

In Jhalawan the plant is used as a cure for stomach-ache.

Baluchistan : Isghand, Izgun— ; *Hamadan* : Zatar— ; *Jhalawan* : Izghand— . *Urdu* : Saatar—.

ZIZIPHORA.

The genus includes 12 species, natives of the Mediterranean region and Central Asia.

1. Much-branched, at the base more or less suffruticose ... *Z. clinopodioides.*
2. An annual herb ... ... *Z. tenuior.*

1. **Ziziphora clinopodioides** M. Bieb. is found in Baluchistan. It is distributed to Afghanistan, Persia, the Caucasus, Armenia, and Syria.

At Jelga in Baluchistan the whole of the plant is dried and kept, and a decoction is used to cure typhus fever; also leaves are soaked in water at night and the infusion is drunk in the morning in cases of heat. In the Harboi Hills the juice is used as a tonic after recovery from fever.

Baluchi : Purchink— ; *Harboi Hills* : Purchink— ; *Persian* : Pudina— ; *Pushtu* : Maurai— ; *Ziarat Hills* : Maurai—.

2. **Ziziphora tenuior** Linn. occurs in the North-West Frontier Province, and Baluchistan. It is distributed to Afghanistan, Persia, Asia Minor, Turkestan, Soongaria, and Siberia.

The herb is used in Baluchistan to allay fever. In Teheran it is employed as a cordial and stomachic.

The seeds powdered and mixed with butter milk are used to cure dysentery in Kila Abdulla. They are used as a cure for fevers in Kharan.

Arabic : Mishkatar-el-mashih— ; *Hindubagh* : Maurai— ; *Iraq* : Za 'tar— ; *Kalat* : Mashnapurchink— ; *Kharan* : Kohipurchink— ; *Khawas* : Tukhammelanga, Tukhumimalayan— ; *Kila Abdulla* : Kahkuti, Tukhammalangai— ; *Kurdish* : Jata, Pung— ; *Quetta-Pishin* : Kahkuti— ; *Shiriz* : Rang— ; *Tank* : Paparboti— ; *Teheran* : Kakuti—.

ON THE FOOD-PLANTS OF INDIAN AGARISTIDAE AND NOCTUIDAE (HETEROCERA).

BY

D. G. SEVASTOPULO, F.R.E.S.

The present is a companion to my paper *On the Food-plants of Indian Bombyces (Heterocera)*, (1940, *Journ. Bomb. Nat. Hist. Soc.*, xli, 817-827). The authorities consulted and abbreviations used are the same as in the previous paper, except that all references to the *Illustrations of Typical Specimens of Lepidoptera Heterocera in the Collection of the British Museum* apply to vol. ix, vol. vii containing no reference to any Agaristid or Noctuid larva. Hampson's *Catalogue of the Lepidoptera Phalaenae* does not include the sub-families *Noctuinae, Hypeninae* and *Hyblaeinae*, whilst Seitz' *Indo-Australian Noctuidae* comes to an end half way through the *Catocalinae*. I have followed Seitz in regard to nomenclature and the arrangement of sub-families.

AGARISTIDAE.

Eusemia Dalm.

E. vetula Geyer—Dioscorea, Smilax (Lep. Phal., Seitz).
E. bisma Moore—Dioscorea oppositifolia (Lep. Phal.), Dioscorea and Batatas (Seitz). (Possibly Bananas is meant). (non-Indian).

Scrobigera Jord.

S. proxima Wlk.—Cissus (Lep. Phal., Seitz).

Mimeusemia Btlr.

M. basalis Wlk.—Dillenia (Lep. Phal., Seitz).

Ophthalmis Hbn.

O. milete Cr.—Cissus (Lep. Phal., Seitz). (non-Indian).

Seudyra Stretch.

S. transiens Wlk.—Vitis.

A number of the Australian and American species of the family feed on Vitis, others on Loranthus, Casuarina, Clarkea, Epilobium and Aenothera.

NOCTUIDAE.

ACRONICTINAE.

Diphtherocome Warr.

D. orion Esp.—Oak, Birch, Beech, etc. (Lep. Phal.). (non-Indian).

Trisula Moore.

T. variegata Moore—Ficus religiosa (Fauna, Seitz).

Acronicta Treit.

Nothing appears to be known of the Indian species; but European species feed on Ash, Privet, Alder, Hawthorn, Polygonum, Salix, Plum, Veronica, Rose, Birch, Oak, Pear, Horse-chestnut, Sycamore, Beech, Cornus, Rubus, Poplar, Elm, Myrica, etc.

Simyra Treit.

S. nervosa Schiff.—Spurge, Sorrel (Lep. Phal.). (non-Indian).

S. albovenosa Goeze—Phragmites, Carex, Typha (Lep. Phal.). (non-Indian).

MOMINAE.

Moma Hbn.

M. ludifica L.—Sorbus aucuparia, Crataegus oxyacantha (Lep. Phal.). (non-Indian).

BRYOPHILINAE.

Bryophila Treit.

B. nilgiria Moore—Lichens (Lep. Phal., Seitz).

Other non-Indian species also on Lichens.

EUXOINAE.

Euxoa Hbn.

E. segetum Schiff.—Roots of Brassica, Rumex, Chrysanthemum (Lep. Phal.), on roots of low plants (Seitz).

E. corticea Schiff.—Chenopodium, Rumex, Trifolium, etc. (Lep. Phal.), various low plants (Seitz).

E. spinifera Hbn.—Grasses (Lep. Phal., mihi).

Rhyacia Hbn.

R. ypsilon Rott.—General feeder (Lep. Phal.), polyphagous on low plants (Seitz).

R. subsequa Schiff.—Various low plants (Seitz).

R. pronuba L.—Brassica, Taraxacum, Rumex, etc. (Lep. Phal.), all low plants (Seitz).

R. orbona Hufn.—Grasses, Ranunculus, Primula, etc. (Lep. Phal.). (non-Indian).

R. c-nigrum L.—General feeder (Lep. Phal.), low plants generally (Seitz).

R. deraiota Hamps.—Menispermum, Viola, etc. (Ill. Het., Lep. Phal.), various low plants (Seitz).

R. dahlii Hbn.—Rumex, Primula, Plantago, etc. (Lep. Phal.).

R. ravida Schiff.—Taraxacum, Stellaria, etc. (Lep. Phal.), various low plants (Seitz).

R. flammatra Schiff.—Taraxacum, Fragaria (Lep. Phal.), various low plants (Seitz).

R. saucia Hbn.—Numerous low plants (Seitz).

Other non-Indian members of the genus feed on Salix, Rubus, Betula and Calluna.

Eurois Hbn.

E. prasina Schiff.—Rumex, Birch, Rubus, etc. (Lep. Phal.). (non-Indian).

Triphaena Hbn.

Non-Indian members of the genus feed on Birch, Hawthorn, Salix, Rumex, Primula, Stellaria, Rubus and grasses.

HADENINAE.

Barathra Hbn.

B. brassicae L.—Brassica, Rumex, Chenopodium, etc. (Lep. Phal.), all low plants (Seitz).

Scotogramma Smith.

S. trifolii Rott.—Atriplex, Chenopodium (Lep. Phal., Seitz).
S. nana Hfn.—Hippocrepis comosa, Coronilla minima (Lep. Phal.). (non-Indian).

Polia Treit.

Non-Indian members of the genus of the section to which the Indian species belong feed on Chenopodium, Salsola, Mesembryanthemum, Oak, Birch, Solidago, Genista, Polygonum, Stellaria, Lonicera, Rumex, Plantago, Trifolium, Cytisus, Anthyllis, Pteris, Chrysanthemum, Sonchus, Achillea, Vaccinium, Grasses, Willow, Elm, Urtica, Brassica, Scabiosa, Taraxacum, Tussilago, Delphinium and Lactuca. The section *Harmodia,* none of which are Indian, feeds on Caryophyllaceae, mostly in the seed-pods.

Hadena Schrank.

H. reticulata Vill.—Silene, Rumex, Primula, etc. (Lep. Phal.). (non-Indian).

Tiracola Moore.

T. plagiata Wlk.—Emilia (Lep. Ceyl., Fauna; Lep. Phal., Seitz).

Xylomania Hamps.

Non-Indian species feed on Lotus, Polygonum and Wild Gooseberry.

Monima Hbn.

M. incerta Hfn.—Oak, Poplar, Hawthorn (Lep. Phal.), various trees and shrubs (Seitz).
Non-Indian species on Salix, Birch, Aspen, Rose, Elm, Carduus and Lysimachia.

Brithys Hbn.—Liliaceae (Seitz).

B. crini F.—Amaryllis (Lep. Ceyl.), Liliaceae (Lep. Phal.), Amaryllideae (mihi).

Polytela Guen.

P. cliens Fldr.—Pancratium tortuosum (Lep. Phal., Seitz).
P. gloriosae F.—Amaryllis (Lep. Ceyl., Fauna, Lep. Phal., Seitz, mihi), Gloriosa superba (Lep. Phal., mihi), Gloriosa (Seitz).

Cerapteryx Curt.

C. graminis L.—Grasses (Lep. Phal.). (non-Indian).

Hyphilare Hbn.—Grasses (Seitz).

H. l-album L.—Grasses (Lep. Phal., Seitz).

Sideridis Hbn.

S. vitellina Hbn.—Grasses (Lep. Phal., Seitz).
S. comma L.—Grasses (Lep. Phal.), various fen grasses (Seitz).
S. unipuncta Haw.—Grasses, Cereals (Lep. Phal.).
S. insularis Btlr.—Grasses (mihi).

CUCULLIANAE.

Cucullia Schrank.

Non-Indian species on Artemisia, Chamomile, Sonchus, Lactuca, Aster, Linosyris, Pyrethrum, Anthemis, Tanacetum, Campanula, Hesperis, Solidago, Scrophularia and Verbascum.

Euscotia Btlr.

E. inextricata Moore—Berberis (Lep. Phal., Seitz).

Dichoniopsis Warr.

D. obliquisigna Hamps.—Oak (Lep. Phal., Seitz).

Crino Hbn.—Low plants (Seitz).

Non-Indian species on Humulus, Lonicera, Cherry, Galium, Origanum, Achillea, Cyclamen, Valeriana, Hieraceum, Leontodon.

Amathes Hbn.

Non-Indian species on Rubus, Salix, Rumex, Primula, Birch and Poplar.

Cosmia Treit.—When young on the catkins or flowers of trees, afterwards on various low plants. (Seitz).

C. gilvago Esp.—Seeds of elm, particularly Wych-elm, not Poplar (Seitz), seeds of Elm (Lep. Phal.).
Non-Indian species on Beech, Poplar, Maple, Salix, Tilia.

Amphipyrinae.

Pyrois Hbn.

Non-Indian species on Elm, Euonymus, Cytisus, Cistus and Lavatera.

Amphipyra Treit.

A. tragopoginis L.—Plantago, Hawthorn, Aquilegia, etc. (Lep. Phal.), a variety of low growing plants (Seitz).
Non-Indian species on Oak, Birch, Elm, Sallow, Dandelion, Hieracium and other low-growing plants.

Mania Treit.—Various shrubs and plants (Seitz).

Non-Indian species on Salix, Rubus, Primula, Ivy.

Dipterygia Steph.—Low plants (Seitz).

Non-Indian species on Rumex and Polygonum.

Parastichtis Hbn.—Grasses (Seitz).

P. funerea Hein.—Grasses (Lep. Phal.).
Non-Indian species on Grasses, Primula and Rumex.

Oligia Hbn.—Stems and roots of grasses (Seitz).

Trachea Treit.—Low plants (Seitz).

Non-Indian species on Atriplex, Rumex, Polygonum, Taraxacum, Grasses.

Euplexia Steph.—Various low plants (Seitz).

E. lucipara L.—Ranunculus, Ligustrum, Ash, etc. (Lep. Phal.). (non-Indian).

Conservula Grote.

C. v-brunneum Guen.—Bracken (Lep. Phal., Seitz).

Eriopus Treit.—Known species on Ferns (Seitz).

E. juventina Cr.—Pteris aquilina (Lep. Phal., Seitz).
E. latreillei Treit.—Ceterach officinarum and Notochloena marante (Lep. Phal.), Ceterach officinarum and other ferns (Seitz).

Calogramma Guen.—Liliaceae (Seitz).

C. festiva Don.—Liliaceae (Lep. Phal., Seitz, mihi).

Prodenia Guen.

P. litura F.—Lantana, etc. (Lep. Ceyl.), Lantana (Lep. Phal., Fauna, Seitz), Antirrhinum, Zinnia, Spinach, Lettuce, Castor and Caladium (mihi).

Spodoptera Guen.

S. pecten Guen.—'Bukoot' (Lep. Phal., Seitz), Grasses (mihi).
S. cilium Guen.—Grasses (mihi).
S. mauritia Bsd.—Rice (Lep. Phal.), cereals, rice (Seitz), grasses (mihi).

Laphygma Guen.

L. apertura Wlk.—Drosera (Lep. Phal., Seitz).
L. exigua Hbn.—Plantago, low growing herbs, Lucerne, Cotton (Lep. Phal.), various low-growing plants, Lucerne, Cotton (Seitz), Lucerne, Indigo, Onions, Chillies, Gingelly, Cowpea, Brinjal, Radish, Amaranthus, Turmeric, Maize, Castor, Sesbania aculeata, S. grandiflora. Eleusine coracana, Coriander, Sorghum, Cotton, Tobacco, Gisekia pharnaceoides (1939, Cherian and Kylasam, *Journ. Bomb. Nat. Hist. Soc.*, xli, 253).

Athetis Hbn.—Low-growing herbage and grasses (Seitz).

Non-Indian species on Stellaria, Rumex, Viola, Grasses, Plantago, Taraxacum, Pulmonaria, Corn, Peas, Sedum, Salix, Rubus.

Acosmetia Steph.—Low-growing plants (Seitz).

A. caliginosa Hbn.—Serratula tinctoria, Sanguisorba, Rumex (Lep. Phal.). (non-Indian).

Proxenus Herr.—Schaff.

P. hospes Frr.—Plantago and low-growing herbs (Lep. Phal.). (non-Indian).

Prospalta Wlk.

P. dolorosa Wlk.—Conyza balsamifera (Lep. Phal., Seitz).
P. capensis Guen.—Acanthads (Lep. Ceyl., Fauna, Lep. Phal.), Acanthus (Seitz), Marigold, Cosmos (mihi).
P. pallidipennis Warr.—Coreopsis (mihi).

Gortyna Treit.—In the roots and stems of marsh plants (Seitz).

G. leucostigma Hbn.—In stems of Cladium mariscus and Iris pseudacorus, etc. (Lep. Phal.), in roots and stems of large water-plants such as Iris pseudacorus and Cladium mariscus (Seitz).

Hydroecia Guen.—In the stems of various low plants (Seitz).

Non-Indian species in the stems of Petasites, Equisetum, Rumex, Valeriana, Peucedanum, Cynara, Carduncului.

Pyrrhia Hbn.

P. umbra Hfn.—Ononis or Geranium pratense, in Assam Siegesbeckia orientalis (Lep. Phal.), on flowers and seeds of Ononis spinosa (Seitz).
Non-Indian species on Melissa, Salvia, Dictamnus, Centaurea, and Succisa.

Calymnia Hbn.

Non-Indian species on Elm, Pear, Plum, Oak, Salix.,

Mudaria Moore.

M. cornifrons Moore.—Silk-cotton (Bombax malabaricum) (Fauna, Lep. Phal., Seitz).

Phragmatiphila Hamps.

Non-Indian species in the stems of Carex and Typha.

Sphetta Wlk.

S. apicalis Wlk.—Diospyros, Nephelium erectum (Lep. Ceyl.).

Sesamia Guen.—In the stems of Gramineae (Seitz).

S. inferens Wlk.—In the stems of Sugar-cane (Lep. Phal., Seitz).
S. cretica Led.—In stems of Maize (Lep. Phal., Seitz).
S. uniformis Dudg.—In stems of Sugar-cane (Lep. Phal., Seitz).

Erastrianae.

Usually on low plants and grasses; a few on lichens or on coccidae (Seitz).

Penisa Warr.—Lichen (Seitz).

P. erythroglauca Hamps.—A minute lichen (Lep. Phal., Seitz).
P. oblataria Wlk.—Lichens (Lep. Ceyl., Lep. Phal., Seitz).

Eublemmoides Beth.—Baker.

E. subangulata Hamps.—The Coccid Maskellia zonata Green (Lep. Phal., Seitz).

Coccidiphaga Spul.—Coccidae on various trees (Seitz).

C. scitula Rmbr.—On the eggs of Coccidae on Fig-trees, Oleanders and Yuccas (Lep. Phal., Seitz), at the Cape on Lecanium hesperidum (Lep. Phal.).

Porphyrinia Hbn.

P. ostrina Hbn.—Carduus and Helichrysum (Lep. Phal.), Carlina and Helichrysum (Seitz).

P. parva Hbn.—In the flower shoots of Inula montana and I. viscosa, Centaurea calcitrapa, and in India in the flowers of Kukraunda (Lep. Phal., Seitz).

P. amabilis Moore—On the Lac-insect Tachardia lacca (Lep. Phal., Seitz).

Autoba Wlk.—On various low plants, some few on Coccidae (Seitz).

A. vinotincta Hamps.—Coccidiphagous, on a species of Lecanium (Lep. Phal., Seitz).

A. pulvinariae Oliff.—On the eggs, adult females and ovisacs of the salt-bush scale Pulvinaria maskelli (Lep. Phal., Seitz). (non-Indian).

A. coccidiphaga Hamps.—On various Coccids, such as Lecanium and Pulvinaria (Lep. Phal., Seitz).

A. abrupta Wlk.—Ficus parasiticus (Lep. Ceyl., Lep. Phal., Seitz), Ficus (Fauna).

A. dubia Btlr.—On the Coccids Lecanium oleae, L. hesperidum and L. testudo, and Eriococcus eucalypti (Lep. Phal., Seitz). (non-Indian).

Phyllophila Guen.

Non-Indian species on Santolina and Artemisia.

Amyna Guen.

A. punctum F.—Croton tiglium and C. aromaticum (Lep. Phal., Seitz).

Lithacodia Hbn.—Known species on Grasses (Seitz).

Eustrotia Hbn.—Carex and grasses (Seitz).

Tarache Hbn.—Low plants (Seitz).

T. urania Friv.—Althaea cannabina (Lep. Phal.). (non-Indian).
T. lucida Hfn.—Malva, Convolvulus (Lep. Phal., Seitz).

MELICLEPTRIINAE.

Chloridea Westw.

C. dipsacea L.—Linaria, Centaurea, Ononis, etc. (Lep. Phal.), flowers of various plants, especially Ononis and Linaria (Seitz).
C. peltigera Schiff.—Ononis, Pyrethrum, Arenaria, etc. (Lep. Phal.), flowers of various low plants (Seitz).
C. assulta Guen.—Physalis peruviana (Ill. Het., Lep. Phal., Seitz).
C. obsoleta F.—Rosebuds (Lep. Ceyl., Fauna), Corn, Cotton, Tomatoes, Rosa, Reseda, Calamintha, etc. (Lep. Phal.), flowers of many plants (Seitz), flowers of Carnation, Antirrhinum, Cosmos, Chrysanthemum (mihi).

Melicleptria Hbn.

M. scutosa Schiff.—Artemisia (Lep. Phal., Seitz).

EUTELIANAE.

They keep rather exclusively—as far as it is known—to the different Anacardiineae (Seitz).

Bombotelia Hamps.

B. jocosatrix Guen.—Terminalia belerica (Lep. Ceyl., Lep. Phal., Seitz).
B. dorsipuncta Hamps.—Semecarpus (Lep. Phal., Seitz). (non-Indian).

Eutelia Hbn.

E. tripartita Semp.—Spondias (Lep. Phal., Seitz).
E. adulatrix Hbn.—Rhus cotinus, Pistacia (Lep. Phal.).

Anuga Guen.

A. constricta Guen.—Semecarpus (Lep. Phal., Seitz).

Paectes Hbn.

P. subapicalis Wlk.—Shorea robusta (Indian Lac Research Institute Report for October 1940).

STICTOPTERINAE.

Stictoptera Guen.

S. subobliqua Wlk.—Garcinia (Lep. Ceyl., Fauna, Lep. Phal., Seitz).

Lophoptera Guen.

L. illucida Wlk.—Shorea robusta (Indian Lac Research Institute Report for October 1940).

SARROTHRIPINAE.

Sarrothripus Curt.

S. revayana Scop.—Oak, Willow (Lep. Phal.).

Plotheia Wlk.

P. decrescens Wlk.—Coffee (Lep. Ceyl., Lep. Phal., Seitz).

Risoba Moore.

R. obstructa Moore—Quisqualis (Lep. Ceyl., Fauna), Quisqualis and Sterculia (Lep. Phal.).

ACONTIANAE.

Earias Hbn.

E. fabia Stoll.—In bolls of the Cotton plant (Seitz).
E. insulana Bsd.—Ceratonia siliqua, Gossypium herbaceum (Lep. Phal.), in bolls of the Cotton plant (Seitz).
Non-Indian species on Populus and Salix.

Carea Wlk.

C. varipes Wlk.—Eugenia xanthocarpa (Lep. Ceyl.).

Beara Wlk.

B. dichromella Wlk.—Celtis orientalis (Lep. Ceyl.), Zizyphus jujuba (mihi).

Westermannia Hbn.

W. superba Hbn. Terminalia (Lep. Ceyl., Fauna, Lep. Phal., Seitz).

Acontia O.

A. malvae Esp.—Malva moschata, Lavatera olbia (Lep. Phal.).
A. graellsi Feisth.—Lavatera olbia (Lep. Phal.).

CATOCALINAE.

Catocala Schrank.

C. nupta L.—Salix, Poplar, Ash (Lep. Phal.).
Non-Indian species on Oak, Birch, Sloe in addition.

Ephesia Hbn.

E. dotata Wlk.—Quercus alba (Lep. Phal., Seitz).
Non-Indian species also on Wild Cherry, Plum, Dog-wood, Crataegus Scrub Oak, Apple, Sloe.

Cocytodes Guen.

C. coerulea Guen.—Boehmeria (Ill. Het.), Great Himalayan Nettle Boehmeria (Lep. Phal.).

Lagoptera Guen.

L. honesta Hbn.—'Baucal' (Lep. Phal., Seitz).

Anua Wlk.

A. coronata F.—Quisqualis indica (Lep. Ceyl., Fauna, Lep. Phal., mihi).
A. indiscriminata Hamps.—Eucalyptus Carea and other Myrtaceae (Ill. Het., Lep. Phal., Seitz).
A. tirhaca Cr.—Pistacia lentiscus, Cistus, Rhus coriaria (Lep. Phal.).

Ercheia Wlk.

E. diversipennis Wlk.—Grass (Lep. Phal., Seitz).

Achaea Hbn.

A. mezentia Cr.—Canthium (Lep. Ceyl., Fauna, Lep. Phal., Seitz).
A. mercatoria F.—Ricinus communis (Lep. Ceyl., Lep. Phal., Seitz).
A. melicerta Drury.—Ricinus communis (Lep. Ceyl., Lep. Phal., Seitz, mihi).

Parallelia Hbn.

P. onelia Guen.—Phyllanthus (Lep. Ceyl., Fauna, Lep. Phal., Seitz).
P. joviana Stoll.—Phyllanthus (Lep. Ceyl., Fauna, Lep. Phal., Seitz).
P. algira L.—Bramble, Sloe, etc. (Lep. Phal.), Ricinus communis (mihi).
P. palumba Guen.—Citrus decumanus (Lep. Ceyl.).

Attatha Moore.

A. regalis Moore—Streblus (Lep. Phal.).
A. ino Drury.—Pipul (Lep. Phal.).

Grammodes Guen.

G. geometrica F. Polygonum persicaria, Cistus salvifolia (Lep. Phal.).
G. stolida F.—Paliurus aculeatus, Rubus fruticosus, Coriaria myrtifolia, Quercus (Lep. Phal.).

Chalciope Hbn.

C. hyppasia Cr.—Rhynchosia minima (mihi).

Hypaetra Guen.

H. discolor F.—Callicarpa maesa (Lep. Phal.).

Mocis Hbn.

M. frugalis F.—Zingiberaceae (Lep. Ceyl., Fauna, Lep. Phal.).
M. undata F.—Desmodium (Lep. Ceyl., Fauna, Lep. Phal.).

Clytie Hbn.

C. illunaris Hbn.—Tamarix gallica (Lep. Phal.) (non-Indian).

Pericyma Herr.—Schaff.

P. umbrina Guen.—A small thorny shrub (Lep. Phal.).
P. glaucinans Guen.—A leguminous tree (Lep. Phal.).
P. albidentaria Frr.—Alhagi camelorum (Lep. Phal.) (non-Indian).

PHYTOMETRINAE.

Syngrapha Hbn.

S. circumflexa L.—Potato, etc. (Lep. Phal.).
Non-Indian species on Larch, Salix, Betula, Erica, Calluna and Urtica.

Phytometra Haw.

P. ni Hbn.—Nettle, Solanum, etc. (Lep. Phal.).
P. daubei Bsd.—Sonchus maritimus (Lep. Phal.).
P. chalcytes Esp.—Urtica, Salvia, Echium, Marrubium, in India on Ficus (Lep. Phal.), Ficus (Lep. Ceyl., Fauna).
P. confusa Steph. Achillea millefolium, Matricaria chamomilla (Lep. Phal.).
P. nigriluna Wlk.—Acalypha (Lep. Ceyl., Lep. Phal.).
P. jessica Btlr.—Antirrhinum flowers (mihi).
P. peponis F.—Cucurbitaceae (Lep. Ceyl., Fauna, Lep. Phal.).
P. orichalcea F.—Coreopsis (Lep. Ceyl., Fauna, Lep. Phal.).
Non-Indian species on Brassica, Tomato, Reseda, Taraxacum, Rumex, Crepis, Chenopodium, Trifolium, Senecio, Mentha, Grasses, Carex, Typha, Sparganium, Iris, Alisma, Hollyhock, Isopyrum, Thalictrum, Lamium, Urtica, Lonicera, Sonchus, Geranium, Malva, Eupatorium, Aconitum, Pulmonaria, Lycopsis, Spiraea, Humulus, Arctium.

Abrostola Ochs.

Non-Indian species on Vaccinium, Urtica, Epilobium, Humulus, Lamium.

NOCTUINAE.

Cosmophila Bsd.

C. fulvida Guen.—Waltheria indica (Lep. Ceyl., Fauna).
C. erosa Hbn.—Hibiscus (Lep. Ceyl., Fauna), Hollyhock (mihi).

Othreis Hbn.

O. ancilla Cr.—Menispermum (Lep. Ceyl., Fauna).

Ophideres Bsd.

O. fullonica L.—Tinospora cordifolia (Menispermaceae) (mihi).

Argadesa Moore.

A. materna L.—Tinospora cordifolia (mihi).

Maenas Hbn.

M. salaminia F.—Mēnispermaceae (Lep. Ceyl.), Menispermum (Fauna).

Khadira Moore.

K. aurantia Moore.—Menispermaceae (Lep. Ceyl.).

Hylodes Guen.

H. caranea Cr.—Acanthads (Lep. Ceyl., Fauna).

Pandesma Guen.

P. mundata Wlk.—Albizzia (Ill. Het., Fauna).

Lacera Guen.

L. alope Cr.—Pisonia, Canthium (Lep. Ceyl., Fauna).

Ischyja Hbn.

I. manlia Cr.—Terminalia, Cinnamonia, etc. (Lep. Ceyl., Fauna).

Azazia Wlk.

A. rubricans Bsd.—Phaseolus (Lep. Ceyl.).

Hypocala Guen.

H. moorei Btlr.—Diospyros (Lep. Ceyl.).

Culasta Moore.

C. minuticornis Guen.—Cocculus macrocarpus (Lep. Ceyl., Fauna).

Plusiodonta Guen.

P. coelonota Koll.—Cocculus macrocarpus (Lep. Ceyl.).

Tinolius Wlk.

T. eburneigutta Wlk.—Thunbergia alata (Lep. Ceyl.).

Pasipeda Wlk.

P. satellitia Moore—Thunbergia alata (Lep. Ceyl.).

HYPENINAE.

Hypena Schrank.

H. proboscidalis L.—Nettle (mihi).

HYBLAEINAE.

Hyblaea F.

H. puera Cr.—Bignoniaceae (Lep. Ceyl., Fauna).

OBITUARY

FREDERICK VICTOR EVANS

1865-1940

Frederick Victor Evans was born on May 16, 1865, and died on the 3rd April, 1940, of acute myocarditis. He was buried in St. Ludnos Cemetery, situated on the top of the Great Orme Head, Llandudno. Of family history there is little to record. His father, Samuel Evans, came from an old Shropshire farming family, dating back to 1604, and died a widower in 1872, leaving a young family of five children of which Frederick was the second son; a younger brother and sister predeceased him. Owing to the death of both parents, education was limited and of a private character.

He went to India with his eldest brother in the year 1886 and after gaining some Indian commercial experience branched out for himself and, with his partner, founded the firm of Evans Fraser & Co. about the year 1892. Retiring from active work in India about the year 1908, he returned to England.

I understand that he was one of the original founders and trustees of the Commercial Gymkhana, Wodehouse Road, Bombay.

In latter years, whilst in Bombay, he found recreation in shikar about the Thana Creek and nearby districts and was fond of camp life. Fishing too took up a lot of his time, and led to his practical support to local fishing clubs and their interest in developing the Lonavla Lakes belonging to the Tata Hydro-electric Scheme into possible fishing areas. Yachting was also one of his joys and with his partner and their sailing boat the '*Piwit*' won several prizes in the Bombay Yacht Club open events.

His interest in the Bombay Natural History Society began some years later. It was about this period that he began stamp collecting, specializing in the stamps of British India and the Indian Native States and nearby countries, he left a very interesting and valuable collection.

He married a widow very late in life and had no children.

He lived a very retired life in England and if there is any meaning in the term 'a Spiritual Home' his certainly was in India, which he loved very much.

Mr. Evans showed his love for India and the city of Bombay in a very practical manner. He was elected a Vice Patron of the Bombay Natural History Society in the year 1928 in recognition of the very generous assistance and support which he gave to the Society. He made several substantial contributions amounting to well over Rs. 15,000 to the Society, which were expended on the Natural History Section of the Prince of Wales Museum, and maintained at his own expense, for over a period of 10 years, the services of a modeller for the preparation of a series of casts of local marine and fresh water fishes. As a result of this generosity

the Society was able to prepare the beautiful series of models in wax and *papier mâché* of local fishes now exhibited in the Fish Gallery of the Prince of Wales Museum, Bombay. Mr. Evans also presented to the Museum the series of beautiful and expensive models illustrating insects in relation to disease. His interest in Bombay is further revealed in the fine collection of pictures and paintings of old Bombay, now exhibited in the Art Section of the Prince of Wales Museum. The Society's *Journal* also benefited by Mr. Evans' generous offer to meet the cost of many of the coloured and black and white plates produced with the serial on Wild Animals of the Indian Empire. His generosity also made it possible for us to publish the very large number of fine illustrations issued with Mr. Mosley's serial on Caddis Flies. Mr. Evans presented the Society with a fine collection of books on Bombay and Western India—many of them rare and valuable editions. His name lives in the good he has done for the city he loved so well.

At the request of Mr. C. McCann, in appreciation of the generous help and encouragement extended to him in pursuit of his natural history studies by Mr. Evans, the late Fr. E. Blatter named a new species of plant as *Kaunpfera Evansii* in his honour. Likewise Mr. H. N. Dixon named a new moss obtained by Mr. McCann from the Naga Hills, Assam, as *Isopterygium Evansii.*

REVIEW

THE FAUNA OF BRITISH INDIA INCLUDING THE REMAINDER OF THE ORIENTAL REGION. Diptera. Vol. VI—Family Calliphoridae. By R. Senior White, Daphne Aubertin and John Smart. (London, March 28, 1940.) Price 18 shillings.

As is detailed in the preface, the history of this volume has been one of delays due to the changes in official posts of the original authors. The major part of the work was carried out by Mr. R. Senior White, partly in collaboration with Major W. S. Patton, I.M.S., who, it was hoped, would have been able to collaborate in completing a volume on the Muscidae. Unfortunately Major Patton's other engagements made it impossible for him to undertake the work, and the senior author of the present volume with the collaboration of the second author and later with the help of the third author has managed to complete only the account of the family Calliphoridae.

The work deals with the subfamilies Calliphorinae, Chrysomyiinae, Rhiniinae and Sarcophaginae of the family Calliphoridae of Calyptrate Flies. 214 species of 37 genera are dealt with in the work, and a departure is made from the other volumes of the series, in that species described from the entire Oriental Region are dealt with in the work. This is due to two reasons, firstly because species of this family are very widely distributed, and secondly 'compared with the more attractive groups of insects, so little collecting has been done, that the Editor agreed to the above extension of plan'. The authors hope that when Assam and Burma are adequately worked out, many of the species now known from farther Eastern areas alone and included in this volume will prove to be Indian in the 'Fauna' sense.

The descriptions of the various species are very detailed, and keys to the subfamilies, genera and species should enable most workers to identify Indian insects of the family without much difficulty. The large number of figures of the various species will also greatly facilitate the task of identification.

As an introduction to the systematic part, the external anatomy of these flies is dealt with in fair detail (pp. 1-16), while a short account of the internal anatomy, particularly the alimentary and reproductive systems, is also given (pp. 16-18). Pages 18-25 of the introductory chapter are devoted to the early stages, bionomics, and connection of these flies with diseases. Collecting and mounting are also dealt with at the end of the same chapter.

The volume contains detailed accounts of the species described up to 1936 and included in the *Zoological Record* for the year, but six species described during 1937, 1938 and 1939 are also listed in an appendix on p. 282.

The publication of this volume will be welcomed by Dipterists in the country, and the senior author of the volume deserves the thanks of all workers for having completed a difficult task under rather trying conditions.

B. P.

MISCELLANEOUS NOTES

I.—RIVERS AS BARRIERS TO THE DISTRIBUTION OF GIBBONS.

There is a curious fact about the Gibbon (*Hylobates hoolock*) which I do not think has been placed on record. It is their apparent aversion to water in any large quantities. My observation shows that they seem to dislike having to swim in order to cross a river of any size, or, of course, it may be that it is a dislike of coming to earth from the trees.

In four years experience in an area of the Sadiya Frontier Tract in Assam, bounded on the south by the Lohit River and by the Brahmaputra after the latter's confluence with the Lohit, on the west by the Subansini River, and on the east by the Dibang River, I never came across a single one of these animals. This area is quite suitable for Gibbons to inhabit, as it consists mostly of thick rain forest and, if they had been present, I feel certain I would either have seen or heard them, for I toured there very extensively every year. Immediately south of this area, i.e. on the south bank of the Lohit-Brahmaputra it is possible to see and hear them almost every day in the jungle at Rangdoi and Kenua and particularly on the Rongdoi-Laikoaghat road. Hence this Gibbon is present on the south bank of the Lohit-Brahmaputra System; but not on the north bank! It is apparent that these rivers form a complete barrier to the spread of this animal into the area mentioned.

It is possible that it is also absent east of the Dibang; but I am not sure of this and cannot say anything about the area west of the Subansiri. The tract of country where I found them absent is very large. It extends for over a hundred miles along the Himalayan (Abor) foothills and has an average width of about twelve miles or more. These foothills to the north of this tract are also quite suitable; but here again the animal is absent. The ordinary common reddish-brown monkey is common both inside this area and also on the south of the Lohit-Brahmaputra outside it.

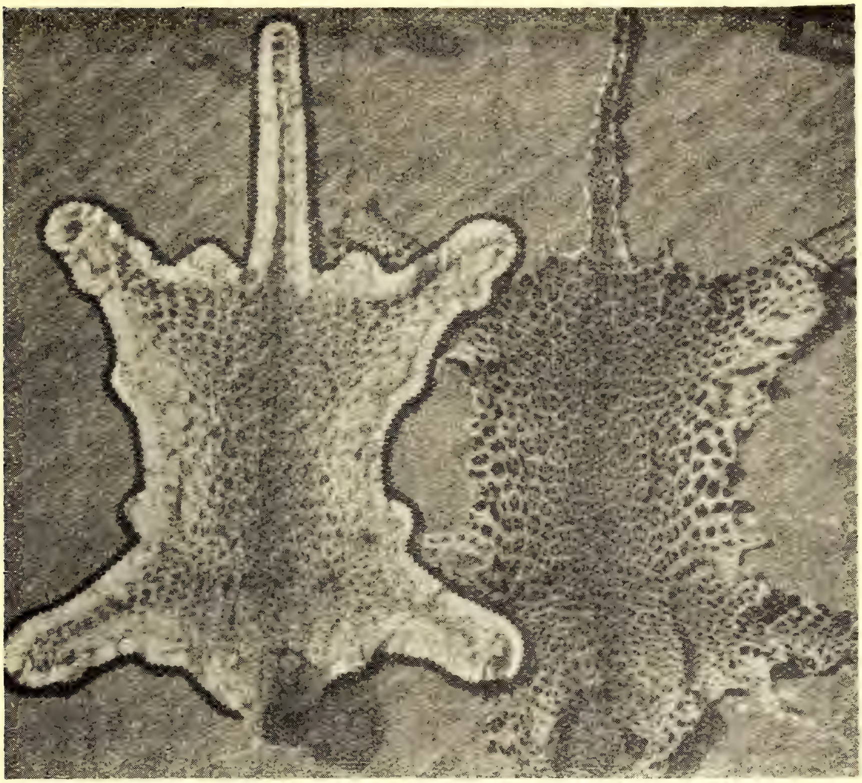
DIBRUGARH,
LAKHIMPUR DISTRICT,
ASSAM, *January* 9, 1941.

R. E. PARSONS,
Indian Police,
F.R.E.S.

[Rivers when they are wide enough definitely form natural barriers to certain groups of monkeys. Macaques readily take to water, but gibbons and leaf monkeys (*Semnopithecus*) appear to have an aversion to water and are usually baulked by a river. Nevertheless both gibbons and leaf monkeys can swim. Mr. McCann tells us that when on the Chindwin Expedition, he put a baby gibbon on a raft to prevent it becoming a nuisance, but it deliberately jumped into the river and swam ashore.—EDS.]

II.—A PALE COLOUR FORM OF THE PANTHER.

(*With a photo*).



A normally coloured panther is shown on the right for comparison.

I enclose a snap of a leopard shot in Dumraon State at the beginning of last year by a Mr. Lessanovitch of Calcutta. The animal is a female, and measured 6′ 2″ between pegs. The eyes were a bright sky blue with no signs of pink, and the only black hairs were at the very tip of the tail.

These latter are not to be found now; so I presume that they must have fallen out during the process of curing. The ground colour of the skin is a pale rich buff, and the spots a dull orange.

There appears to be only one other instance of a leopard of this colour from the Hazaribagh district which is not very far from the State in which the present animal was shot.

CALCUTTA, H. A. FOOKS.
January 16, 1941.

[The most usual form of colour variation in panthers is a tendency to melanism; black panthers are fairly common. More

rarely the opposite phenomenon—albinism, partial or complete, is seen. The instance recorded above is such a case of semi-albinism. It is interesting to note that this is the second record of its kind from Behar. A specimen from Hazaribagh, presented to the British Museum by Mr. R. F. S. Thomas, is described by Pocock (*Journ. Bombay Nat. Hist. Soc.*, vol. xxxiv, p. 69) as having the ground colour paler than usual with tan spots.—Eds.]

III.—A BROWN FORM OF THE HIMALAYAN BLACK BEAR (*SELENARCTOS THIBETANUS*).

A brown example of the Himalayan Black Bear (*Selenarctos thibetanus*), the property of General Sri Rudra Shum Shere Jung Bahadur Rana of Nepal, was secured in the jungles of a Himalayan valley in Nepal territory.

The general coloration of this bear was a rich brown resembling the Russian Brown Bear (*Ursus arctos*), muzzle a light brown, and a pale chest mark. From the characters of the dentition there is no mistaking this bear skin for the Himalayan Red or Isabelline Bear (*U. arctos isabellinus*).

We have had several specimens of the cinamon-coloured variety of the Sloth Bear, which are not uncommon. H. H. The Maharaja of Dewas Senior has a large male of this colour alive in his Zoo.

Van Ingen and Van Ingen, BOTHA VAN INGEN.
Mysore, S. India,
January 23, 1941.

[Pocock in his monograph on the Black and Brown Bears of Europe and Asia (*Journ. Bombay Nat. Hist. Soc.*, vol. xxxvi, p. 110) gives two records of brown specimens of the Black Bear: one of these was an example of the Baluchistan race (*S. t. gedrosianus*), which came from Mekran, and which Blanford, on account of its colouring, originally mistook for a Brown Bear. The second was a specimen shot by Major Stockley in the Kashmir Valley, which again was mistaken for a 'red' bear. Messrs. Van Ingen sent the skull of the Black Bear referred to in his note to the Society and we have verified the correctness of the identification.—Eds.]

IV.—THE INDIAN WILD DOG.

Under the head 'Fluctuating Population' in the article on the Indian Wild Dog, at page 713 of Volume xli, the possibility of rabies being a contributing cause is mentioned; and it is remarked that record of only one case of rabies could be found.

I have now come across an instance in a book *Mauled by a Tiger* by Arthur W. Strachan (1933). The Author writes:—

> 'I know of no instance of these beasts having made a concerted attack upon human beings, or even cattle, but on rare occasions single individuals affected with rabies have endeavoured to bite natives, and I once shot one in the last stages of this dread disease. It had 'treed' a coolie, but it could not possibly have bitten him as its lower jaw was completely paralysed and hung open.'

5, BENSON CROSS ROAD,
BANGALORE,

R. W. BURTON,
Lt.-Col.

April 5, 1941.

V. VILLAGE DOGS HUNTING.

In the fascinating article by Burton—'The Indian Wild Dog'—in your latest *Journal,* I was interested to read the portion dealing with 'red colour pariah dogs' mentioned by Forsyth in his *Highlands of Central India.* I have never been so fortunate as to shoot in the C. P., so cannot add anything to the subject of wild dogs of those parts, and even the *Cuon* of these parts, the Terai, and Siwalik hills have never obligingly revealed themselves to me.

The mention, however of the 'red colour pariah dogs'—which presumably means 'domesticated' or 'semi-domesticated' *village dogs,* calls to mind a most interesting sight which I witnessed in the Timli (East) Reserved Forest (Dehra Dun Divn:), one evening last November. I had done a prowl through a bit of the Timli village zemindari forest, on the off chance for shot at jungle fowl, but had had no luck, and I had emerged on to the 100′ fire line separating the reserved forest from the village land when I saw four village 'pie' dogs walking up a stony 'rao' or dry nullah from the village. They stopped when they reached the edge of the reserve forest. Here they stood with their heads close together, it seemed, and appeared to confer for some time. At this moment, a slight movement on my part made them aware of me, and the sudden change in the attitude of these four dogs (two were black with an odd white 'sock' or so, each, one was black-and-white pied, while the last was raffia-coloured—all smooth-coated), was remarkable—each pretending to be unaware of the others, one cocking his leg against a handy root, while another had a sudden urge to do a spot of 'fleaing' but all had their eyes on me, a hostile and unwinking stare!! I now emerged into the open, and as my way to the waiting car lay past where the dogs were, I calmly approached, slipping I'll confess, the cartridges back into my gun, as I did so. None made any effort to efface him/herself and as I came opposite them, one, the largest 'black' growled in no friendly manner, but made no advance and I passed them (the dogs), by noting that all had their 'hackles' raised and all still eyed me narrowly. As soon as I was out of sight of the dogs, I quietly slipped behind the tall grass and sal scrub and silently observed

the dogs. They remained as I'd just seen them, for a minute or so and then without hurry they separated, the 'raffia' and one 'black' together carrying on up the nullah, while the 'piebald' and the other 'black' turned off the nullah at right angles and disappeared into the forest. The former two went off at a steady lollop up the ravine, but the latter remained unhurried, and moved very silently.

I've heard since that these village dogs hunt in similar—and larger—parties and like Cuon—but possibly to a smaller extent—do damage to the herds of chital, and also pull down an occasional sambhar hind. The young of peafowl, jungle fowl and partridge must also suffer from these village dogs.

I wonder whether any of the other members have seen anything similar. There are, of course the dogs which hunt with the Kamjars or gipsies, but those are trained (?) and hunt *with* their owners. It couldn't have been a case of a bitch 'in season' with three *beaux*—this spirit of easy harmony and understanding and conferring together would *not* have been apparent—to say the least! and the family *Canis* is not so bashful as to retire into forest fastness for his courtship. Any way, I will appreciate your own views and those of any member who may have seen a similar event.

ARCADIA T.E., W. P. KEELAN.
DEHRA DUN, U.P.,
October 15, 1940.

VI.—VITALITY OF A HYAENA (*HYAENA STRIATA*)

While out on a Gasht today a striped hyaena got up in front of the forward platoon who shot it. I don't know how rare these are up here, but I have never heard of one before, though some of the men say they are very common. But on the other hand some of them thought it was a panther, and others said it was in the habit of killing camels. It seemed in good condition except that one of its hind feet was missing from some previous injury; but I cannot think what they live on here as the hills are bare and barren. All flocks are driven in at night, and though a dead camel would do it well, dead camels are not as common as all that. The vitality of this animal was amazing. It was hit by a ·303 bullet at close range and apparently the bullet broke up, because there was a huge hole in the belly out of which the liver and stomach (?) were protruding when found. In addition a piece of intestine ten feet long had come out where the hyaena was first hit and this it had apparently bitten off for it was found on the ground. After biting it off the hyaena had gone down a very steep nullah about two hundred feet, and a hundred feet up the other side where it was finished off. There was a very broad blood trail all the way, and it is astonishing that an animal could lose so much blood and still continue to run. We took the head and neck and the tail, but had to leave the rest owing to lack of time. While skinning the head we found a leech about 1½″ long in one of the nostrils.

MIRANSHAH, T. J. PHILLIPS,
N. WAZIRISTAN, N.W.F.P., *Tochi Scouts.*
December, 1940.

VII.—ON THE OCCURRENCE OF THE CHAFFINCH (*FRINGILLA COELEBS* [LINN.]) IN WAZIRISTAN.

These are far commoner visitors to India than is generally supposed. On the 16th February this year (1940), there were two or three cock birds here, and early in March there were about half a dozen of each sex; but I had not then a copy of the *Fauna* and consequently took little notice of them, except that they seemed duller than the English bird. For the same reason I cannot be sure, but I think they were then singing, rather a weak little song. I have been unable to get dust shot so I am afraid this specimen also is a bit battered. He was sitting on a branch calling, which was what drew my attention to him though I had seen him a few days before.

MIRANSHAH,
N. WAZIRISTAN, N.W.F.P.,
December, 1940.

T. J. PHILLIPS,
Tochi Scouts.

[The specimen of the Chaffinch was sent to us by Mr. Phillips. We have been able to verify the identification. It was obtained by him at Datta Khel 4,000 ft. in the Miranshah District, North Waziristan. In the New *Fauna* one previous record is given. This is a specimen obtained by Capt. C. H. T. Whitehead at Hangu, 25 miles north of Kohat.—EDS.]

VIII.—VULTURES AND PALMS.

Going to and fro by train to work and home again, I often wonder how many people have given a thought to, or observed the gradual, but sure disappearance of palm trees, particularly of the Brab Palms (*Borassus flabellifer* L.) on either side of the railway track, and beyond. This gradual disappearance of the palms is most noticeable after leaving Bandra station (going north), and is not entirely due to the development of the suburbs, but also to the presence of large numbers of white-backed vultures (*Pseudogyps bengalensis*) in attendance on the Bandra slaughter house. The crowns of the palms afford most convenient roost for the vultures, which naturally use them. Though vultures 'shoot' out their excrements to a considerable distance, they do not always fall clear of the palms. In course of time the crowns of the palms are smeared white with the acrid excreta. The leaves gradually get 'burnt' and dry up, and it is not long before the crown dies, leaving a bare 'pole' standing. Rot soon lays the stem low. The vultures are now forced to find a fresh roost. Thus, one by one the palms are gradually disappearing. It is only the tallest palms that are thus affected. As vultures generally do not roost for the night below a certain height, the young palms escape till they become tall enough.

It is surprising to find in what a short time the vultures kill the palms. A few random observations showed that certain palms succumbed after two and three years of use, while others dragged on for a couple of years or so more. Palms with slanting stems

seemed to survive a little longer than those with vertical stems. Palms, which had been abandoned as roosts, sometimes recovered after a while.

Coconut palms (*Cocos nucifera* L.) are also used as roosts, but on the whole are less affected, as they do not usually reach the same height as 'brabs', and the fronds are less adaptable to carrying a number of these large birds.

This is not a plea to destroy the vultures, they are by far too useful as scavengers, in spite of their ugly appearance and habits, but is merely intended as a record to show how trees may be destroyed by the excreta of some birds.

Incidentally the life and distribution of two insectivorous birds, the Palm Swift [*Tachornis bat. batasiensis* (Gray)] and the Swallow Shrike (*Artamus fuscus* Vieillot.) are bound together with the distribution of the Brab Palm, which both these birds use as roosts and nesting sites. The disappearance of the palms from Salsette may result in the disappearance of these birds, but I do not think there is any immediate danger of this taking place—Nature will, I think, take care of that.

BOMBAY NATURAL HISTORY SOCIETY, C. McCANN.
BOMBAY,
December 2, 1940.

IX.—SANDGROUSE COMING TO WATER AT MIDDAY.

It may be of interest to your readers to know that whilst in British Somaliland recently I noticed the Pin-tailed Sandgrouse (*Pterocles alchata*) flighting in and watering at 1-30 p.m. This struck me as very unusual for a species which normally waters in the early morning and occasionally in the evening. I would mention that the place where these birds were bathing was the only water hole for several miles.

ADEN, R. C. NICHOLAS,
September 30, 1940. *Major.*

X.—SCARCITY OF SANDGROUSE DURING THE COLD WEATHER 1939-1940.

Have any of your members remarked on the scarcity of the Common Sandgrouse (*Pterocles exustus*) this year? During the cold weather of 1939-40 I was at Ramdurg, S. M. Country, and shot about 100 sandgrouse. I spent last Christmas there and had previously warned my old *shikari* to look out for good places for sandgrouse, but on my arrival he reported that he could not find any. I went to an old haunt of these birds, but there was not one to be seen. The uplands round Mudhol are typical places for sandgrouse, but I have seen very few. It is not a matter of scarcity of water as there are rivers here and at Ramdurg where the birds drink.

MUDHOL, E. O'BRIEN,
S. M. COUNTRY, *Lt.-Colonel.*
January 16, 1941.

XI.—HABITS OF THE SEESEE PARTRIDGE (*AMMOPERDIX GRISEOGULARIS GRISEOGULARIS*).

With reference to the habits of the Seesee Partridge, as noted in the *Fauna,* I think that Stuart Baker is mistaken about the double whistle call. They are the commonest game birds here by a long way, and I have never heard it, nor have any of our men whom I have asked. The only noise I have heard them utter is a soft *chuck chuck* from one to another in the covey, and the noise from which they get their names is the *see see* noise they make with their wings as they take off—a high pitched squeak like a badly oiled bearing. Another habit of theirs is not mentioned. In the heat of the day they seem to leave the plains and go to rocky outcrops where they hide in deep cracks and crevices, always preferring these cracks to even the shadiest stones. Also when wounded they always run to the nearest hole or crack in a rock, if there is one anywhere near by. They do not hide up in the middle of the day to the same extent in the cold weather, but even unwounded birds, when frightened, will fly into a hole in a cliff, and under these circumstances I have put out seven or eight birds in the cold weather out of one rock. Protective colouration is very highly developed in these birds, and I have had ten men searching an area of bare stony sand for three or four minutes before finding a dead bird lying there back upwards. So without a dog a wounded bird out of sight is as good as lost.

Big coveys of twenty birds or so are difficult to approach, because when they disappear over a ridge they almost invariably leave a sentry; but two or three birds together practically never do this, and if one runs forward they can usually be found just below the crest of the ridge or in the nullah below.

MIRANSHAH,
N. WAZIRISTAN,
N.-W.F.P., *December* 1940.

T. J. PHILLIPS,
Tochi Scouts.

XII.—CURIOUS NESTING SITE OF THE RED-WATTLED LAPWING (*LOBIVANELLUS INDICUS INDICUS* BODD.)

(*With a photo*)

Mr. K. Bocker sent me a couple of photographs of a Red-wattled Lapwing's nest which had been placed 'on a heap of ballast between two railway tracks in Ghosrana Station yard (Alwar State)'. The nest contained three eggs. Mr. Bocker commenting on the behaviour of the bird wrote, 'Every time a train came in the bird flew up, only to return to its domestic duties immediately the train left.' The photographs were taken early in September.

The position of the nest between two frequently used railway tracks, and in a station yard, is certainly rather unusual for a bird which is generally very careful to hide its nesting position. Another point of interest is that this lapwing generally has its nest

near water, on the banks of lakes or in the beds of rivers. According to the *Fauna* this species usually lays in April and May, but

eggs have been found in June and July. In this instance the bird laid in September, several weeks later than usual.

Bombay Natural History Society,
Bombay, C. McCANN.
November 13, 1940.

XIII.—RECORDS OF SWINHOE'S SNIPE IN ASSAM.

Swinhoe's snipe (*Capella megala*) are not the rarity that they were some years ago, but they are still comparatively uncommon. It may be of interest to record that three have been shot in the neighbourhood of Shillong recently. I killed the first in a valley some three miles west of the station on September 15. Major W. L. Neal, I.M.S., shot the second, 13 miles west of Shillong on September 28. I shot the third on the high plateau south of Shillong on October 30.

The first and last were solitary birds. The second was lying close to another snipe which we failed to bag.

Brightwell, J. C. HIGGINS.
Shillong, Assam,
November 8, 1940.

XIV.—OCCURRENCE OF SWINHOE'S SNIPE IN BENGAL.

In view of the paucity of published records of the occurrence of Swinhoe's Snipe (*Capella megala*) in North India, it may be of interest to record that a specimen, sent to you herewith, turned up in a bag of 33 couple, consisting of 56 pintail snipe, 9 fantail snipe

and the Swinhoe, made by me on September 29 last, a few miles from Naihati, which is some 24 miles north of Calcutta.

The ground consisted of young paddy with swampy grassy patches here and there, which had not been cultivated, and the birds were also found sheltering from the sun in the shade of bushes and patches of jungle dotted about in and around the paddy.

The Swinhoe which, in the preliminary separation of the bag by looking at the undersides of the wings, had been placed amongst the pintails, attracted attention on account of its large size; a closer examination and a look at the tail disclosed its identity. Besides the quite distinctive tail, this particular specimen seemed to me to differ from most pintail snipe in the following respects :—

1. It was definitely large, even for a pintail; so much so that it attracted special attention.
2. The legs seemed to be rather longer.
3. The bill appears to me to be longer and more slender than is the case with most pintails, while the knob at the extremity of the upper mandible, although present, does not seem to be quite so pronounced.

These are personal impressions only, however, and the differences mentioned are certainly not sufficiently pronounced to enable identification without an examination of the tail, except for which, the bird is extraordinarily like a pintail snipe.

This is the first Swinhoe's snipe to turn up in a total of over 16,600 snipe representing an aggregate of bags made since season 1926-27, practically all within a radius of about 40 miles from Calcutta, in which I have been personally interested and all of which have definitely ben carefully examined for unusual species and varieties.

CALCUTTA, R. J. CLOUGH.
November 23, 1940.

XV.—MOULTING OF COMMON TEAL SUBSEQUENT TO MIGRATION TO INDIA.

(*With a photo*).

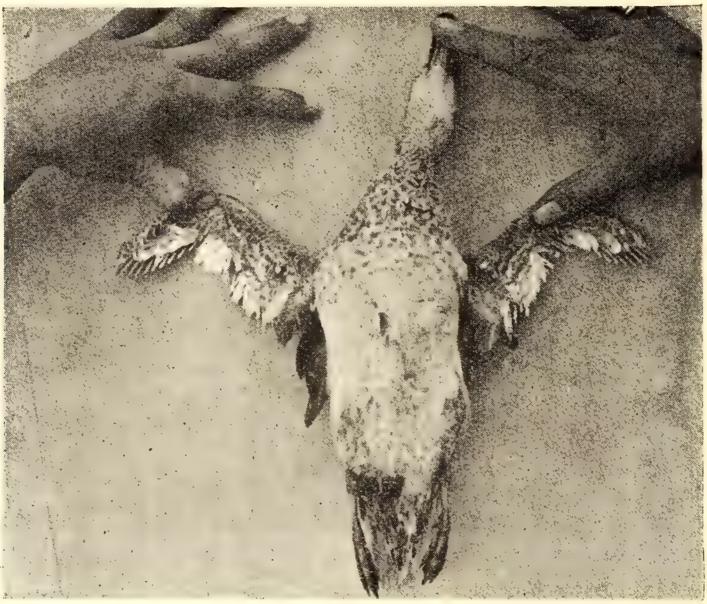
I am sending you by this evening's train a teal shot yesterday in Bikaner, i.e., on October 4, this year.

2. It is not certain, but in all probability, it was not shot flying on account of its wing condition, but must have been shot on the water when picking up wounded birds.

3. I send some photographs which have been taken, in case the bird does not arrive in good enough condition. However, I think, you will be able to see the condition of its wings at any rate. There is no doubt that the bird could not have migrated with its wings in their present condition. Such a long flight would have been impossible, in this condition, it was really quite unable to fly. Last year the lake was completely dry, so it could not have been a wounded bird left behind from the previous year.

4. The only feasible explanation is that it migrated and arrived at the end of August or early in September in the lake, and for

some unnatural and extraordinary reason, moulted after arriving here. A lot of feathers on both wings are in a growing state and still bluish in colour and soft.



5. I should be much obliged by your kindly letting me know what you think is really the case. Particularly, whether the teal, which appears to be a young bird, could have migrated in its present wing condition, or whether it could fly, even slowly, in this condition.

BIKANIR, SECRETARY TO
October 3, 1940. HEIR APPARENT OF BIKANIR.

[We have examined the teal (*Nettion creca*) which was in complete moult. The *Anatidae* (Ducks and Geese), unlike most birds—moult all their wing quills simultaneously and not pair by pair. They thus become completely flightless for a period.

Mr. Sálim Ali who was concerned with the carrying out of scientific bird surveys on behalf of the Society writes as follows:—

'Till I caught several such flightless teals and shovellers for ringing on the Ghana Jheel in Bharatpur last October (1939), I did not know that some of our migrant ducks underwent the complete post-nuptial or autumn moult after flying thousands of miles to their winter quarters on their old remiges (wing quills). This condition is not recorded anywhere in Indian bird books, as far as I know.

'Most of our winter visitors have already finished moulting their wing and tail quills before they arrive in our midst. This is, as one would expect, considering the long and hazardous journey over the Himalayan barrier that must be accomplished, to reach their winter quarters in India,

'Some individuals among the ducks, however, seem to be in such a hurry to get back to their winter quarters—(they often arrive as early as August or September) that they forsake their breeding grounds before the autumn moult has begun and go through this process at this end. Such birds, presumably, are yearlings that will not breed till the second season. They cannot be, at least the ones I examined were not—juveniles of the same season.'—EDS.]

XVI.—OCCURRENCE OF THE STIFF-TAILED DUCK AT NOWSHERA, N.-W.F.P.

As an old member of your Society, I thought you would like to know that we shot a Stiff-tailed Duck (*Erismatura leucocephala*) on the Kabul River on November 31, 1940. We were going downstream in a boat when we suddenly came on the bird below a rapid. It refused to fly off the water although we passed it quite close, but as the boat was going very fast, and we thought we should not get a further chance we shot it on the water. It appeared to be on examination either a female or young male. The tail was very scraggy but very distinctive, also was the beak. I compared it with Stuart Baker's book, and it undoubtedly was a Stiff-tailed Duck.

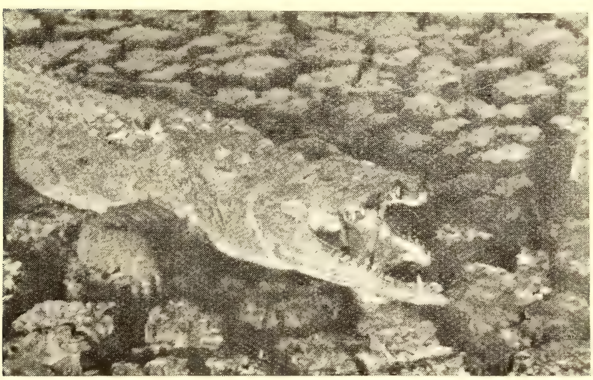
I thought it might be of interest to you. It was a lone bird.

THE MALL,
NOWSHERA,
December 3, 1940.

F. F. FIELD,
Lt.-Colonel.

XVII.—INJURY TO A CROCODILE.

(*With a photo*).



The accompanying photo of a Marsh crocodile (*C. palustris*) is of interest. Having shot the crocodile, I found the mouth parts completely disfigured by a former bullet wound. The injuries involved both the upper and lower jaw which, as will be seen from the photo, were partly shot away. How the animal fed under these

circumstances is a mystery. The wounds had healed perfectly and the reptile was in good condition.

NILAMBAG PALACE, R. K. DHARMAKUMARSINHJI.
BHAVNAGAR,
September 27, 1940.

XVIII.—FOOD OF LIZARDS.

I was very interested to see the record (*Journ. Bomb. Nat. Hist. Soc.*, vol. xlii, p. 49) of three larvae of *Parasa lepida* Cr. (not 'Gam.') being taken from a *Calotes.* I recorded the eating of this larva by *Hemidactylus* sp. in 1936 (*Proc. R. Ent. Soc. Lond.* (A) 11: 91-2). Lizards seem to pay little attention to the colouring of the larvae they eat and I have fed *Hemidactylus* sp. on the larvae of *Polytela gloriosae* F. and *Chilasa clytia* L., both typically aposematic in appearance, the one being purple-black in colour blotched and spotted with orange and white, the other black and cream with large rose pink spots. Hairiness seems to afford protection as neither the larva of *Pericalli ricini* F. nor of *Trabala vishnu* Lef. were eaten. (1939, mihi, *Proc. R. Ent. Soc. Lond.* (A) 14: 33-4).

CALCUTTA, D. G. SEVASTOPULO.
December 30, 1940.

XIX.—A NEW FAMILY OF FISHES.[1]

The discovery of a new vertebrate, so distinct from all previously known species as to warrant the erection of a new family for its reception, remains a zoological event of outstanding importance. Double significance is attached to the find, when, as in the discovery under review, the new species may rightly be claimed to be one of the most highly specialized and bizarrely modified members of its class.

Early in 1937, while studying fish life in brackish waters of the Bombay Province, C. V. Kulkarni encountered small, surface-swimming specimens which he first took to be the young of some goby or cyprinid fish, but which later turned out to be mature adults of an unknown species. When submitted to ichthyologists in India and America, the novelty was pronounced a new type, referable to the Order of small fishes known as Cyprinodontes. It was interpreted as a distant relative of the common Indian species, *Oryzias melastigma,* and was presumed to have been evolved from some such fish. It has gone so far on its own special line of evolution, however, that it seemed unwise to classify the new type in the same family (*Cyprinodontidae*).

Dr. George S. Myers and the reviewer were both struck by the extreme likeness of the Indian novelty to the tropical American genus *Tomeurus.* Even in the features of extreme specialization, the resemblance appeared so close that at first examination the two fish seemed to be close relatives. It seemed impossible that Nature

[1] On the Systematic Position, Structural Modifications, Bionomics and Development of a Remarkable New Family of Cyprinodont Fishes from the Bombay Province, India. By C. V. Kulkarni. *Rec. Ind. Mus.*, vol. xlii, pp. 379-423, figs. 1-20, 1940.

could have twice molded a fish into such an extreme form. On more penetrating scrutiny, however, some fundamental, hidden differences came to view, so that both of us concluded that *Tomeurus* and the then-unnamed Indian genus arose independently from the cyprinodont groups that are respectively characteristic of the two regions.

In designating the new fish *Horaichthys setnai,* Mr. Kulkarni has jointly commemorated the names of Dr. Sunder Lal Hora, India's distinguished ichthyologist, and Dr. S. B. Setna, Fisheries Officer of Bombay. Though not unduly long as scientific cognomens go, this name is slightly longer than the fish. One wonders how this thin, translucent wisp-like inch of fish can be so packed with specializations.

Horaichthys is peculiar in many ways. The small dorsal fin is set far back, almost against the caudal fin. The anal fin is much elongated. The anterior anal rays make a lobe on the females, and in the male are set apart to fabricate a marvellously complex structure, with special hooks and appendages and skeletal supports,—all of which are described in admirable detail. This structure is termed a gonopodium, from its resemblance to the similar though less extreme structure which serves as an intromittent organ in the *Poeciliidae,* a family of viviparous American cyprinodonts. The organs in the two groups are said to be homologous, as they are comprised essentially of rays 3, 4 and 5 of the anal fin, but this view can hardly be accepted by those who interpret unity of descent as a criterion of homology. In *Horaichthys* the gonopodium is utilized to transfer spermatophores (sperm-filled bundles) from male to female. These, the first true spermatophores to be recorded in fishes, are provided with a complex head of spines by which the sperm bundle is attached to the skin of the female, in the region of the genital opening. After attachment the wall of the bundle swells at a point near the spines and discharges its contents of male germ cells. The spermatozoa swim into the oviduct and there fertilize the eggs for some days. Dermal folds and ridges on the female ('genital pads') seem to aid in the attachment of the spermatophores. The usual lack of a right pelvic fin (a wholly unique feature) might be thought to serve the same function, though the author, in a Lamarckian view that seems rather strange today, states that 'it may be presumed that by such constant striking [of the gonopodium], the right fin has in the course of time been reduced and ultimately lost.'

Following wise suggestions from Dr. Hora, the author withheld the description of this marvellous little fish until it was possible to study its structural modifications, habitat, feeding and mating habits, deposition of eggs, and the structure and development of the egg and 'larva' (postlarva). All these observations were made in detail, with an eye that sees below the surface. For the completion of this outstanding contribution to their science, the ichthyologists of the world owe thanks to Mr. Kulkarni and his Indian associates.

Ann Arbor, Michigan, U.S.A., CARL L. HUBBS,
October 4, 1940. *University of Michigan.*

XX.—ADDENDA TO THE LIST OF SIMLA BUTTERFLIES.

(*Journal, Bombay Nat. Hist. Soc., vol.* xli, *p.* 716)

Parnassius simo simo, Gray.
Eight ♂ from the Shipki La, 14,000′, in July 1940.
Baltia butleri butleri, Moore.
♀ ♂ from the Shipki La, 14,000′, in July 1940.
Euploea mulciber mulciber, Cramer.
♂ caught in Chota Simla at 7,000′, on August 8, 1940.
Hesperia alpina alpina, Ersch.
Several specimens from the Shipki La, 1,400′, in July, 1940.

BISHOP COTTON PREPARATORY SCHOOL,
SIMLA, E.
November 8, 1940.

M. A. WYNTER-BLYTH, M.A.

XXI.—BUTTERFLIES ATTRACTED BY MOIST EARTH.

(*Miscellaneous Note No.* xx, *Journal, vol.* xlii, *p.* 206).

Collenette, in a paper which I have not got with me, suggested that perspiration was a potent source of attraction in South America. He also remarked that most patches of damp earth or sand would attract butterflies if one or two dead ones were placed on it as decoys. In Shillong I found *Terias* spp. very common on patches of damp earth.

CALCUTTA,
December 30, 1940.

D. G. SEVASTOPULO.

XXII.—SUPPLEMENTARY NOTES ON THE LIFE HISTORY OF THE MOTH (*BRAHMEA WALLICHII*

I have a few notes to add to the admirable life histories of the large moth *Brahmea wallichii*, Gray which have been published during the last few years; viz., *Journ. Bombay Nat. Hist. Society*, vol. xxviii, page 593 by Graham, and *Journ. Darjeeling Nat. Hist. Soc.* No. 1 June 1938 by Scott.

I obtained a female of this species, a rather battered and deformed specimen, on the trunk of a fir tree at Laitlyngkot in the Khasia and Jaintia Hills on May 25, 1940. It had laid seven eggs on the bark of the tree singly, and it looked as if an attempt had been made to insert the eggs into cracks in the bark. It laid a further five eggs in the box in which it was put. The colour of these particular eggs were quite a deep yellow and had no other markings that I could see. I was on my way to Darjeeling at the time so the eggs were not observed very closely until some ten days later when it was noticed that they had turned a deep mauve colour. Shortly after the larvae emerged. It is noted by Lt.-Col. Scott that in Shillong the food plant is *Ligustrum robustum* Blume and by Major Graham as *Fraxinus macracantha*. I could find neither of these in Darjeeling. I did however find *Ligustrum confusum* Dene and made vain attempts to make the larvae eat it;

but they resolutely refused and most of them died. *Fraxinus floribunda* Wall is a fairly common tree in Darjeeling and this was tried with success. They fed well after this. The point of interest is that although the larvae will eat two species of the genus *Fraxinus* they will not eat a second species of *Ligustrum.*

I also observed that sometimes the empty egg shells were entirely eaten, but were only partially eaten in other instances. I did not however note that the cast skins were eaten. I found that they were left untouched in all cases.

I was unfortunate with the surviving larvae however. I managed to rear them to the penultimate instar when they all died as a result of being unable to cast the last skin. From my observations it is apparent that where the humidity is very high, as it is in Darjeeling during the monsoon, the larvae are very delicate, especially if they are not kept well ventilated—in the open air if possible. I was unable to do this not being in my own home. The high humidity seemed to prevent the old skin from drying sufficiently for it to be shed. It appeared to stick to the spiracles. I had a good deal of difficulty with each instar except the first, when the skins were in the process of being changed, as a matter of fact; but the last was the worst. The larvae were inclined to be lethargic and did not eat well when it was cold. The height of Laitlyngkot is 6,000 feet. It is apparent that to rear the larvae of this species successfully it is necessary to keep them as dry as possible when in captivity and very well ventilated.

ASSAM, R. E. PARSONS,
November 3, 1940. *Indian Police,*
F.R.E.S.

XXIII.—LARVA OF *THERETRA LYCETUS* CR. PARASITIZED BY TACHINID FLIES.

With reference to Mr. McCann's note on the same subject in the last issue of the *Journal,* I have several times had a similar experience with larvae of *Rhyncholaba acteus* Cr. The very noticeable caking of the underlying soil is, presumably due to the amount of fluid contained in the body of these large larvae.

CALCUTTA, D. G. SEVASTOPULO.
December 30, 1940.

XXIV.—*LAGERSTROEMIA INDICA* AS A FOOD-PLANT OF *ACTIAS SELENE.*

(*Miscellaneous Note No.* xxii, *Journal*, *vol.* xlii, *p.* 208)

I have found this shrub most useful in rearing many species of larvae whose proper food-plant I did not know. The Saturniid *Philosamia cynthia* Drury eats it readily, and in Shillong I found cocoons of *Dictyoploca simla* Westw. on it in numbers. Probably most Saturniids would eat it. Of the other families, almost all Lymantriids will eat it, as will many Limacodids.

CALCUTTA, D. G. SEVASTOPULO.
December 30, 1940.

XXV.—THE DEATH EXPEDITION OF HIBISCUS CATERPILLARS.

(*A Correction*).

There seems to be a mistake in the identification of the species referred to in this article (*Journ. Bomb. Nat. Hist. Soc.*, vol. xlii, p. 164). *Crocallis* (presumably Treit.) is the name of a genus of Geometrine moths with smooth, looper caterpillars very different from the hairy larvae shewn in the plate. It is difficult to make an identification from the information given in the note, but I feel fairly confident that the larva in question is *Eupterote geminata* Wlk. This is a common species in Calcutta and the larvae are often to be found abundantly on various trees and shrubs, the branches of which they cover with a coating of silk.

CALCUTTA, D. G. SEVASTOPULO.
December 30, 1940.

XXVI.—ABNORMAL SEEDLING OF *MANGIFERA INDICA*, LINN. N. O. ANACARDIACEAE.

(*With a text figure*).

Mango seedlings were raised for the class work. Among these an abnormal seedling was noticed.

A normal seedling consists of a main tap-root with its branches, two cotyledons, and a shoot (epicotyl) bearing young immature leaves.

In the abnormal seedling (Fig. 1) abnormalities were present in the root and the shoot region, while the cotyledons only remained normal. Instead of a single tap-root with its branches, it was noticed that several roots were given out. In all there were eighteen roots of various lengths. The shoot system consisted of a main primary normal shoot and five axillary secondary shoots. The main primary shoot was stout and it remained enclosed inside the endocarp. At the base of this shoot, in the axils of the cotyledons, five secondary shoots were present—one in one axil and four in the other. Of these four axillary secondary shoots, one showed fasciation of three axes. The union of the axes was unequal. At the base, all the three axes were united. Higher up the outer axis got separated while the inner one was composed of two united axes. The latter also was separated again at the apex. Of these four secondary axillary shoots, two were longer than the rest. On the longer shoots, young tender leaves were present, while on the two short shoots, only rudimentary leaves resembling scales were present.

When this seedling was uprooted the only part that was above ground consisted of the two longer shoots, one with normal axis and the other with the fasciated axis. The remaining shoots and cotyledons remained inside the endocarp.

Abnormalities in the seedlings of Mango have been recorded by Masters (3), Khanna (1) and Sen and Mallik (5).

The abnormal seedling described in this note differs from the

one cited by Masters (3) in the following respects: (i) Adventitious roots are not manifested on the cotyledons. (ii) There is absence of an increased number of embryos. According to Khanna (1) embryonic shoots were given off from the part just near the endocarp as well as from the extreme part of the cotyledons. Such is not the case with this seedling. It also differs from one described by Sen and Mallik (5) in that there is absence of a single tap-root.

These axillary secondary shoots were the result of the occurrence of buds in the axils of the cotyledons. The presence of the buds in the axils of cotyledons and the development of shoots from them is of rare occurrence. Similar type of instances are recorded

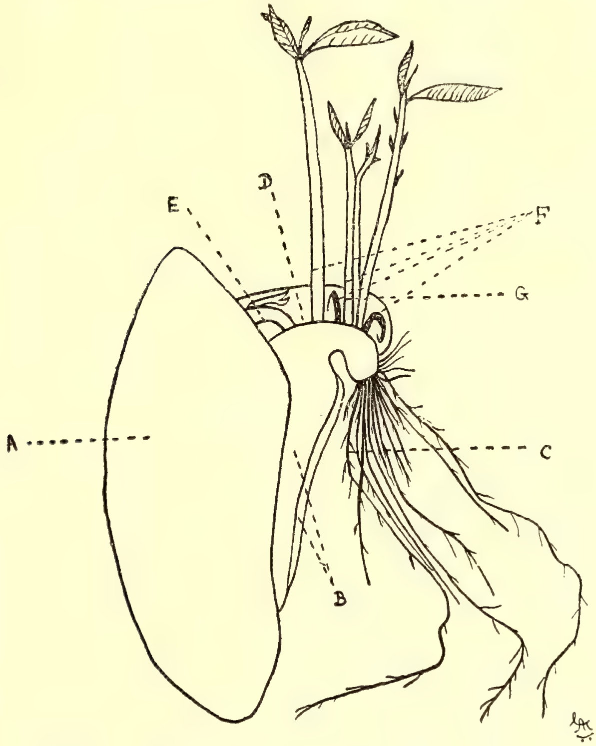


Fig. 1. Abnormal Seedling of *Mangifera indica* Linn. showing:—

(*a*) endocarp: (*b*) cotyledons: (*c*) roots: (*d*) main primary normal shoot: (*e*) single axillary secondary shoot: (*f*) four axillary secondary shoot No. 1-4: (*g*) fasciation of three axes of shoot No. 2.

in *Cassia Tora, Impatiens Balsamina, Vicia faba, Tropaeolum majus, Ricinus communis,* and some others by Tiwary (7) and in *Cicer arietinum* by Singh (6). The present case differs from that of Tiwary (7) in that there is absence of fasciated shoot. According to Singh (6) if the plant is decapitated close to the cotyledons, either in the seedling stage or a little later, axillary shoots are invariably developed in due course. There is nothing like decapitation in this case.

Sachs (4) and Lopriore (2) produced at will fasciated shoots in the axils of the cotyledons of the Scarlet Runner (*Phaseolus multiflorus*) by excising the main axis of the plumule at an early stage; if this mutilation is performed at a later stage, no fasciation results. Worsdell (8) repeated these experiments with marked success. He produced fasciated shoots in the axils of the cotyledons of majority of seedlings. In every case the shoot was only affected at the base. The rest of the shoot showed the normal growth. The present case agrees with those of Sachs in having fasciated shoots; but this is a natural phenomenon and not the result of mutilation.

BHAUDDIN COLLEGE, G. A. KAPADIA, M.SC.
AHMEDABAD,
December 1940.

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XXVII.—SOME WILD FLOWERS OF KASHMIR AND THEIR INDIGENOUS USE.

One of the beauties of the charming valleys of Kashmir is their wild flowers. I mean those valleys which are above the tree-belt where shepherds make their homes during the summer months. Where there is less grazing, the flowers thrive and we see beds of floral vegetation in diverse colours. Sometimes we see islets right in the middle of a torrent, covered with pink, yellow or orange flowers.

Almost all the flowers of these high altitudes have medicinal qualities. There is a great scope for a scientist or a medical man to analyse these herbs. There are some men who know the uses of certain herbs, but they are loath to impart this knowledge to others. When they die this knowledge also dies with them.

The most esteemed of all these herbs is *Saussurea sacra*. This is commonly known as Jog-Pádsháh. It grows above 14,000 ft. in crevices between rocks and slabs with very little earth in them. The herb is like a fleecy ball, exactly like a cat's head without ears.

The flowers are tiny, of purple colour in pappus. The leaves are lower down and are in large numbers. It appears shining like a star. It grows on the Harmukh, in the Sonasar pass, and from Romesh Thong (the Sunset Peak) to Tatakoti. It grows in large quantities. We saw a large bed of these flowers round Makor Nág, when, in 1937, the C. M. S. School masters climbed the last-mentioned peak. There are many who have never seen this flower. I met a Sadhu last year in the Nishát Bágh and he told me that he had spent months round about Khrew and Tár-Sar trying to find the herb. He said that he wanted to collect plants enough to give him juice weighing two seers ! (almost an impossibility).

It is believed that the head of the herb when powdered and drunk with boiled milk, abates fever and cures internal disorders. It is also used for snake-bites, and as a poultice for boils.

Two other plants found at almost the same height are *Allardia glabra* and *Pleurospermum.* The former grows on sandy soil among rocks, and creeps along the ground. The flower is like a daisy. The flowers of the disk are yellow, while those of the ray are purple or pink. The latter flower resembles hemlock (Mohora Kach) more or less. The plant is about 7″ high. Both those specimens were found near the Kila peak (Harmoukh) and the Sonasar Nág peak. The drug which the physicians esteem most is *Macrotomia Benthami,* known as Kahzabán. There is no decoction prescribed by native physicians in which this drug is not used. An infusion of the leaves is believed to be good for heart trouble. A jam is prepared from the flowers of this plant. The flowers are pounded and mixed with double the weight of sugar and exposed for forty days in a jar in the sun. It is said that the root burnt and mixed with ghee cures burns.

Mertensia tibitica is a small plant with dark blue flowers having a long corolla tube. It grows at a height of about 13,000 ft. It has been found on Aphorwat, Yechini Pass (Kunsar Nág) Mahádive, and Hamsadwar.

Sedum wersii grows among rocks. The flowers are pink. The leaves are sessile opposite, broad and thick. It is called 'Dandas' and the chewing of the stem is believed to cure toothache. It grows on Aphorwat, Mahadive, Gangabal and Harmoukh. *Rheum webbianum* is commonly known as Pambá hák. The leaves are boiled and cooked with fish or without. The root is pounded and mixed with oil to cure wounds. It is then called Pamba tsálan. The petiole of the leaf and young shoots are generally red and the former is boiled in sugar for eating purposes. It grows on Mahadive and high margs.

Polygonum amplexicaule bears red flowers on the top of the plant. The leaves lower down are long and narrow. The root is called montsaran and is used to stop bleeding.

Jurinea macrocephala. This plant is found at a height of about 12,000 ft. The leaves are radical, ashy-coloured, long and deeply lobed. The flower is like that of a thistle surrounded by leaves. The root is used as incense when mixed with other scented drugs, such as camphor etc. It is called *Dhup.*

Saussurea Lappa. This is the famous plant known as Koṭh.

The leaves are long and broad resembling those of pumpkin leaves. The petioles have small wings attached to them. A group of 3 or more thistle-like flowers grow at the top of the stem. They are of a dark colour. Here and there we found the plant at Erin Nallah, Kanital, and Kishen Ganga valley. There are many places where the forest department is cultivating this useful plant. In 1927 we saw a large tract at Gossai in Grurais valley where this drug was being cultivated.

The root of the plant is supposed to be very useful. Its mention in *Yagupavit* ceremony shows that its use was known from the earliest times. When a new well is dug a piece of the root is put into the water to clean it. One part Koth and two parts cane sugar is supposed to cure ulcer of the stomach. The dose is as large as half a pea.

It is also powdered and in sesamum oil rubbed on a rheumatic limb. Its uses in China are manifold. It also serves the purpose of naphthalin. *Aconitum heterophyllum* (Monkshood) is a flower of high margs. The leaf is more or less Cordate with toothed edges. The plant is l[illegible]n by pattis. The root contains two tubers one big and the other small. Hence the other name for it is nar mada (male and female). The tuber is ground and used as medicine for fever. It is as good as Quinine. It grows in Gurais, Gosai and Purmandal.

Aconitum Chasmanthum is called 'Mohand'. The flowers are collected and made into a kind of 'Khamir' jam. Double the weight of sugar is pounded with the flowers and kept in a jar in the sun for 40 days. It is a tonic and good for rheumatism. A large dose is poisonous. It is generally taken in winter months. It grows in Tosa Maidan, Purmandal and Dánzeb. The root is ground, mixed with oil and rubbed on a rheumatic limb.

Fritillaria Roylei is known by the name of Shithkár (cures 80 diseases). The root is bulbous. I saw a shepherd boy roasting the bulb in ashes and eating it. It cures stomach trouble. The bulb when dry is mixed with curds and applied to burns. It grows in Gulmarg and Mahadive.

NATURAL HISTORY DEPARTMENT,
C. M. S. HIGH SCHOOL,
SRINAGAR, KASHMIR,
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